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MEETING OF THE NORTHWESTERN ELECTRICAL ASSOCIATION.

The Northwestern Electrical Association is rapidly becoming recognized as an association before which papers of exceptional value and interest are read. Its meetings are awaited by the technical press and its papers watched for by engineers with the greatest interest. The association meets twice yearly, the first meeting of 1898 being held in Milwaukee, commencing January 19. The programme and the names of the authors promise highly, and if the standard set in the last few meetings is maintained or excelled the meeting will be a most beneficial one.

SMALL MULTIPHASE INSTALLATIONS.

There is still in the minds of business men connected with the electrical interests, and to a certain extent of electrical engineers also, a feeling that multiphase alternating current systems are something not as yet well understood and not adapted for everyday use, but capable of application in large power transmission installations or other works of great magnitude where special machinery and a high grade of engineering talent may be obtained. For small plants and ordinary lighting and power distribution service where the system is to remain in charge of mechanics not versed in mathematical knowledge, the multiphase system is often thought of as unavailable. This, however, is not the case. The multiphase generator is really no more complicated than the single-phase of long-established use. The lines require no more skill and knowledge in installation than do the lines of the three-wire Edison system, and the transformers are the same as those for single-phase lighting plants. The motors are far simpler and less troublesome than direct-current motors.

Evidence of the satisfactory operation of multiphase machinery in a small installation is given in an article in another column, describing a plant which has been in use for two years for the purpose of transmitting power to points where an inflammable mixture of oil fumes and air was likely to occur, and direct-current machinery was therefore out of the question. This plant, although running every day in the year for all but a few minutes of the twenty-four hours, has never been shut down for any fault in the electrical machinery, a record that any direct-current service could not excel.

The multiphase systems thus at this early stage of their development seem to be giving as good results as the old-established direct-current systems, and there is no reason why they should not be employed, even in isolated plants for pure lighting and power service in buildings. The use of direct current at 110 volts in large isolated plants involves very expensive feeders, switches, bus bars and switchboard equipment, and in spite of almost every precaution the resistance losses are serious, owing to the practical impossibility of making metallic contacts of sufficiently low resistance for large currents at this low voltage. The drop between the commutator and the brushes and in the main switches of a large 110-volt dynamo may cause a constant loss of several horse-power. An alternating system can be readily arranged for such work with three, four or five-wire supply and simple inductive balancing coils, thereby reducing greatly the cost of copper and the losses therein.

THE DUTIES OF THE CONSULTING ENGINEER.

A great deal of hard feeling has grown up in electrical circles owing to the lack of a proper understanding of the exact relations of the purchaser and consulting engineer and the builders of electrical machinery. The large contracting firms have in many cases made a practice of guaranteeing a first-class installation from their own plans and designs, and this guarantee, in the light of their reputation, has been considered by the astute business man to render a consulting engineer unnecessary. The construction houses have often felt themselves forced to such a course by the obstructive and antagonistic attitude of the consulting engineer. A proper cooperation between the two is not, as it is often considered, an indication of bias or dishonesty on the part of the consulting engineer, and it should be further cultivated, as indicated in the excellent paper by Mr. S. Dana Greene, which is abstracted in another column.

THE WEAK POINT OF INTERIOR WIRING.

During the last few years interior wiring has passed through a most remarkable development, advancing from the cheaply insulated wire fished into place and fastened on wooden cleats to the high grade of wire in a highly insulating covering, protected in a heavy iron pipe, with solid cast iron or steel junction boxes and panel switchboards of the most substantial construction. In all these particulars practical perfection has been reached, as far as insulation, protection and reduction of risk is concerned, although there is still plenty of room for improvement in point of first cost.

The socket, however, remains practically what it was a decade ago. In one sense it is the most exposed part of the system. It is constantly being handled, and is subject to jerks and blows and strains of all sorts. Crowded in it are the exposed terminals of opposite polarity, and a number of small metallic parts. These are stamped or punched out of sheet or thin strip metal, and assembled in a form quite unsuited for the severe duty which they often must endure. It is probably a fact that nine-tenths of the short circuits and other troubles with interior wiring may be traced to the sockets. Alternate heating and cooling, the jerking of the key, and the twisting in of lamps require at this point a solid structure, instead of a frail assemblage of weak brass and porcelain pieces.

RAPID TRANSIT IN PARIS.

The condition of the French capital with regard to transit facilities is even worse than that of New York. It appears that the æsthetic sensibilities of the Parisians are offended by overhead trolleys, and that the city is waiting for the perfection of a closed conduit system. Meanwhile people walk or ride in horse-drawn cabs or in the sumptuous vehicles of the Compagnie Générale des Omnibus. In the suburbs a few electric roads have been built, but their success is naturally hampered by their inability to carry passengers to the central parts of the city. As our French correspondent notes this week, the long discussion of the subject in the Municipal Council has resulted in a definite decision to limit the motive power of proposed tramways to electricity, without specifying in what way it shall be utilized, and in fixing the rate of fare at 10 centimes (about 2 cents) without specifying that this is to be a flat rate or whether or not a distance limit can be put upon it. It is all very vague. The Metropolitan line, vigorously talked about some time ago, does not seem to show signs of a very vigorous vitality. What Paris needs just now is another Haussmann, or at least, a little of his courageous iconoclasm infused into the spirits of its Municipal Council. It is greatly to be hoped that there will be some sort of awakening there before the Exposition, although the time is short for the construction of proper railway facilities.

ELECTRIC LIGHTING AND GAS.

The increasing use of Welsbach and other incandescent gas burners has been a source of some anxiety to electric lighting companies who have found that, notwithstanding the many points of superiority possessed by the incandescent lamp, it is being displaced to a considerable extent in some quarters by the mantled gas jet. Inferior as it is in cleanliness, color, coolness and other desirable qualities, the new gas light is so cheap, and is apparently so much cheaper than it really is, that it is making inroads of no small magnitude into the business of central stations. And it has come to stay. There can be no denial of this, because the incandescent burner is a remarkably meritorious and valuable invention. It increases the luminous efficiency of gas anywhere from five to seven times, and this at a comparatively small cost. While it has numerous and obvious defects it possesses the great and shining merit of cheapness, and hence its use.

The operation of these burners depends upon the substitution for the carbon particles precipitated from the decomposing compounds constituting ordinary illuminating gas, of a filmy "mantle" or bag of threads of certain oxides of rare metals, zirconium, thorium, cerium, etc. These substances possess the property of radiating a great proportion of the energy emitted by them when they are heated as light waves. Carbon heated to the same temperature would give out a greater proportion of heat and less of light. This substitution, aided by the fact that in the mantled burner air is admitted and the gas burned at a higher temperature than when issuing as a luminous flame from the ordinary fish-tail burner, makes a difference of as much as five to seven times in the amount of light obtainable from a given quantity of gas.

Electric current cannot be supplied at prices much below those now obtaining unless some radical and hitherto unthought of improvement in steam engines is made or the secret of its direct generation from fuel energy discovered. In order to reduce the price of electric light the efficiency of the lamp must be bettered, there being much room for this improvement. It seems unfortunate that carbon, the only available material that will stand the temperature necessary for incandescent lamp filaments, should have a very low light emitting power—indeed the lowest. Why should not a lesson be learned from the enterprising makers of the new gas lamps? There seems to be no reason why a filament should not be coated with zirconia, or why this material may not be incorporated with the carbon-forming compound of which the filament is made. It would certainly enormously increase the efficiency of the lamp.

While the electric light is amply able to hold its own in most quarters, there is little doubt that there will be always a large field in which the chief quality sought in an illuminant will be a low price. It is also true that if the price of incandescent lighting could be reduced, leaving the station the same percentage of profit, the increase in the quantity of business would pay handsomely. There is thus every incentive for the production of some form of lamp of much higher efficiency than those now in use. The suggestion contained in the last paragraph is made simply for what it is worth—because it looks as if this is a direction in which experiment might be productive.

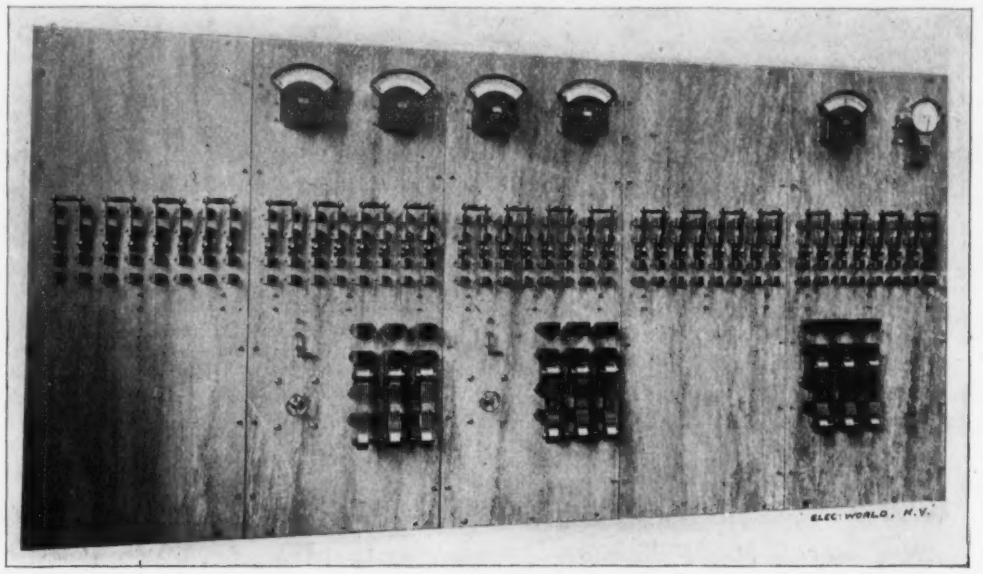
Meeting of the Henry Electrical Society.

The next meeting of the Henry Electrical Society will be held at Columbia University, Engineering Building, on January 21, when Mr. D. R. Lovejoy will deliver a lecture on "The Induction Coil and High Potential Discharges." The lecture will treat of the practical design of the induction coil, and will be illustrated by many experiments showing the various effects obtainable.

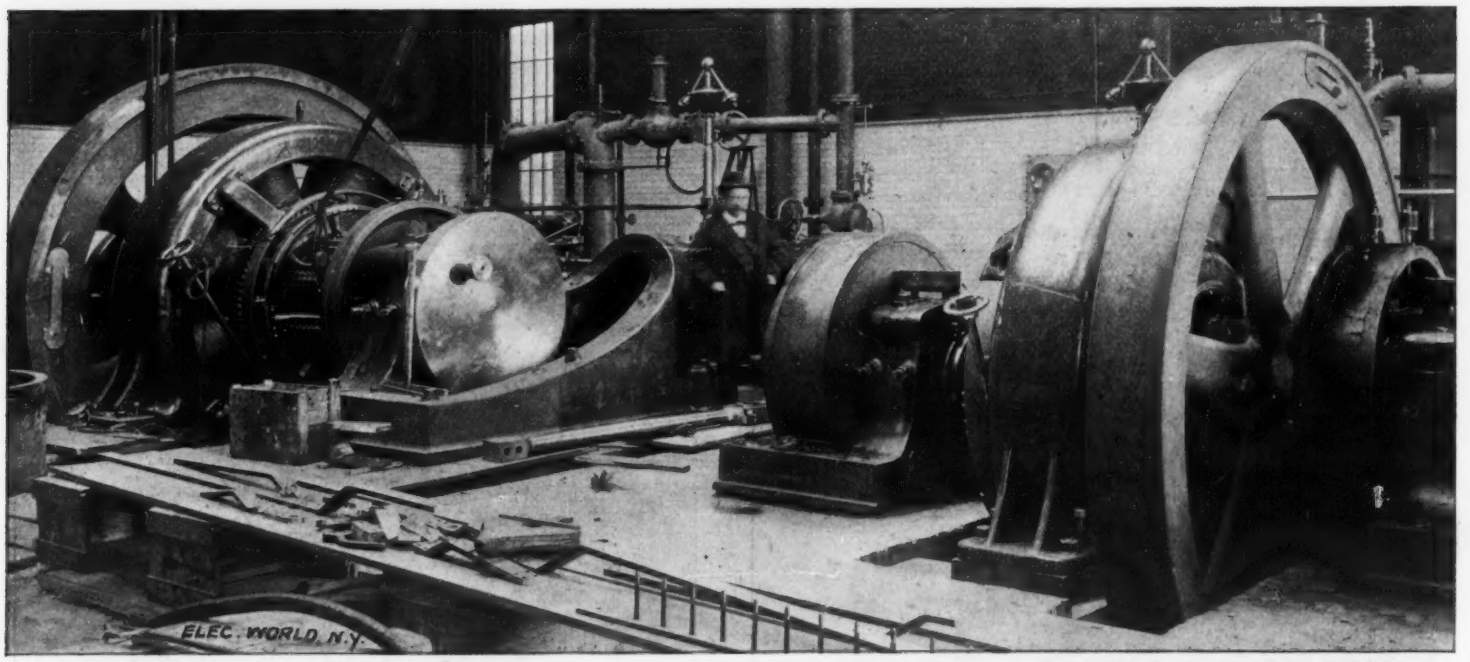
The Electric Plant of the Government Printing Office—II.

The generators were built by the Crocker-Wheeler Electric Company. These machines have eight poles; the cores of the field magnets are of steel, round in shape, and cast solid into the yoke. This yoke is of cast iron, and has an internal flange on each side, which partly covers the field coils, affording them considerable protection from mechanical injury, and at the same time allowing good ventilation. The poles are provided with removable screws after the field coils have been slipped into position. These shoes diminish the density of the magnetic flux in the air gap, thus permitting a long gap to be used, which is of great value mechanically.

The armatures are of large diameter and short length. They are cable wound in such a way as to be equivalent to a bar winding. The slot insulation consists of tubes made up of several layers of micanite, press boards and oil muslin, rolled up and glued together. Two tubes are slipped into each slot, one above the other. Each tube contains four conductors. The conductors, on coming out of the slot, bend downward toward the shaft and pass under a large ring, then upward again and into another slot about 45° from the first slot. When the winding has been put on the core it is held down by clamps at each end, and the connections of the coils are made to the commutator. The commutator tails are sufficiently long to keep cool and hold the solder, even if the commutator should by accident become overheated. The coils are usually connected so that there are eight circuits in the armature, though connections can be made for a two circuit winding. The windings of these machines are impervious to moisture and dust, and the manner in which they are applied to the core permits such ample ventilation that severe overloads can be withstood without destruction of the insulation, although they may raise its temperature above normal. The armature core is mounted on a cast-iron spider which has an extended sleeve upon which the commutator is mounted. The commutator is of large diameter and sufficiently large face to secure ample surface of brush contact. The number of commutator bars is such as to keep the difference of potential between adjacent bars low. The commutator tails are riveted to the bars. The whole armature is thoroughly iron clad, and can be rolled along the floor without injury. It can also be stood up on end without harm to the windings. A great feature of these machines is the method of supporting the brush rods, which obviates clumsy cable connections between brushes of the same polarity. A large circular cast-iron rocker ring divided into two parts is used, supported by brackets attached to the yoke of the dynamo. This rocker ring carries, insulated from it, two large copper rings of circular cross section, and also supports, insulated from it, the various groups of brushes at the lines of commutation. One of these copper rings is connected to all of the positive brushes, and the other one is connected to all of the negative brushes. Shifting of the brushes is obtained by rotating the cast-iron rocker ring by means of a tangential hand screw. On account of the room saved by this arrangement, it can be placed next to the armature, thus leaving the commutator very accessible from the outboard bearing end. The individual brushes can be easily examined and withdrawn for cleaning and adjustment while the dynamo is running. The keeping of the carrying ring close to the frame not only leaves the commutator free and easy of access, but greatly enhances the pleasing appearance of the dynamo. The brushes are carbon, held in parallel movement radial holders, and are of ample size to carry the current at low density per square inch of contact with the commutator.



FIVE PANELS OF THE MAIN SWITCHBOARD.



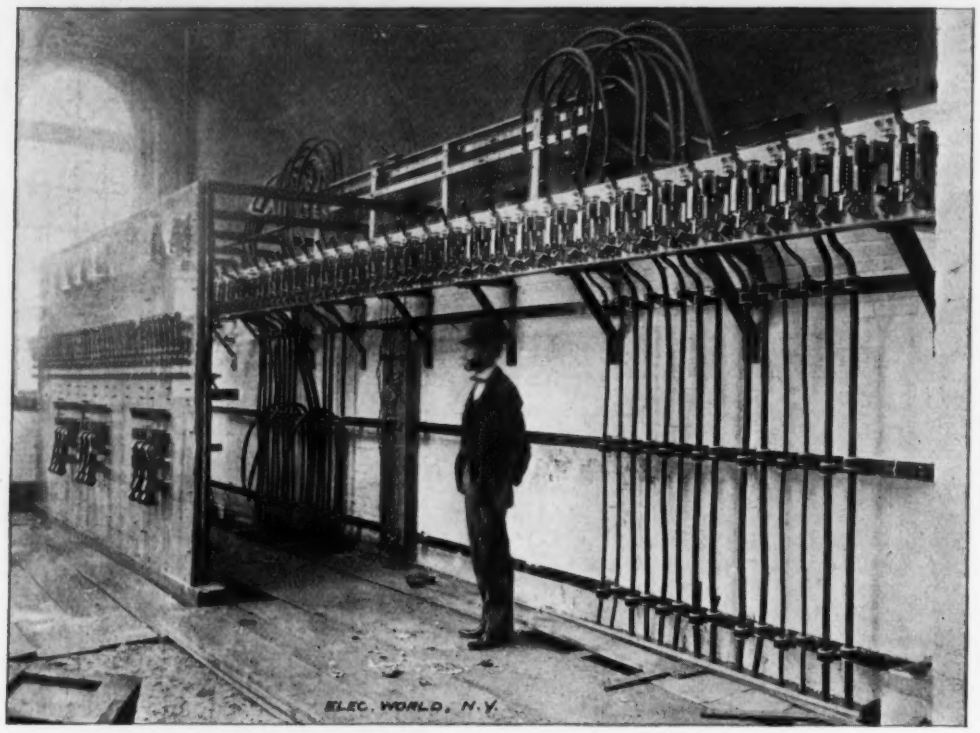
MAIN GENERATING UNITS.

The switchboard consists, or rather will consist when completed, of ten panels, with a total length of 36½ feet. The Crocker-Wheeler Electric Company has just installed five panels. The old switchboard, consisting likewise of five panels, will be moved and set up

alongside of the five panels just put in. All the panels are alike, of pink Tennessee marble, 1¾ inches thick, 9 feet 1 inch high, and 43 inches wide. Of the five new panels, two are for generators, two are for feeders, and one is for connecting the new board to the old.

The panel for the 300-kw generator is provided with a 3000 ampere Weston ammeter and a 150 v. voltmeter, with illuminated dials. These instruments are hinged, so that they may be swung normal to the panel, in such a way that they can be seen from the end of the switchboard. This panel is also provided with a triple pole double throw knife switch, capable of passing 3000 amperes, the middle pole being for the equalizer. A Carpenter field regulator is also mounted on the back of the board with its wheel on the panel. A 3000 ampere Cutter circuit breaker is mounted about 18 inches back of the switchboard on a small auxiliary slab supported from the large board. The panel for the 125-kw generator is similar to the first, with the exception that the ammeter measures only up to 1500 amperes, and the circuit breaker is also smaller. The triple pole double, throw knife switch has, however, 3000 amperes capacity. Each of the five panels has four 150 ampere double pole double throw feeder switches. The end panel is provided with a 3000 ampere triple pole double throw knife switch for connecting the new board to the old one, and also has a Bristol recording voltmeter and a double reading illuminated dial Weston voltmeter with ground detector switch.

There are two sets of bus bars and two equalizers, all of the same size, 3 x ¾ inch cross section, made of bar copper. By their means and the switches connected to them, any desired combination can be made with the four separate generators which will comprise the complete plant. Connections between the switchboard and the generators are made with lead covered cables having a cross-section of 1,000,000 circular mils. The circuit breakers are mounted on separate marble plates, which are bolted in a long row to a steel frame behind the main board.

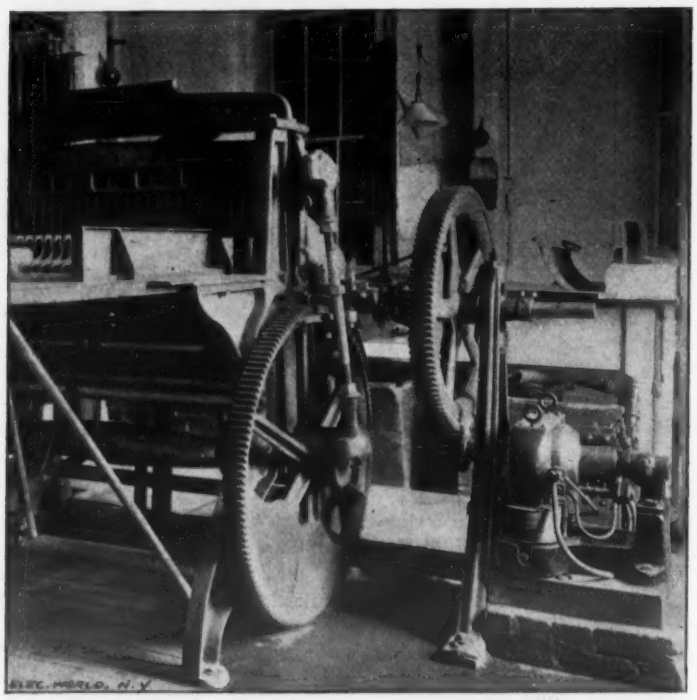


Switchboard and Row of Forty Circuit Breakers.

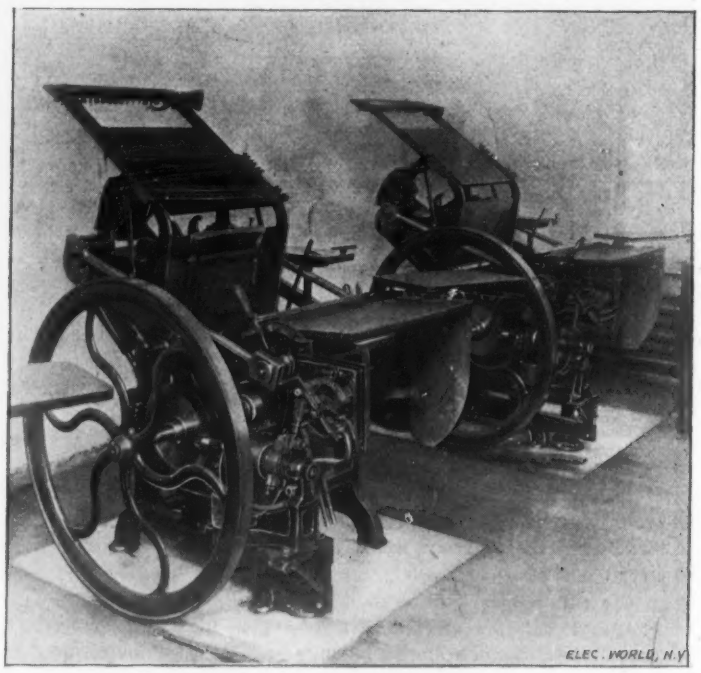
The breakers are designed for extra large carrying capacity. The construction is such that the current is carried through laminated contacts in series with the actuating coil of the instrument. The main break is between the laminated contacts, and is followed almost simultaneously by the auxiliary break, which is in shunt with main contacts, and is itself protected by a final carbon break of ample capacity. All the features which have made the smaller types so successful are preserved in these devices, while the arrangements of the laminated contacts are such that the circuit breaker can be set with no greater effort than is required in closing an instrument carrying 50 amperes.

The application of motors to the great variety of machines in the printing office presented many complicated problems to the chief electrician. One by one they were carefully studied, and that they have been well solved is evidenced by the large variety of rigidly connected machines now running satisfactorily. At present presses of all sizes are so operated, from large web presses, printing at the rate of 11,000 per hour, down to an eighth medium Gordon press.

One press, called the "speech press," prints, cuts, binds and counts the speeches. This combination is especially compact, as the motor is located directly beneath the press. Next to this is another which prints on both sides the return postal cards for registered letters



3-hp Motor Geared to Paper Cutter.



½-hp Motors Bevel-Geared to Job Presses.

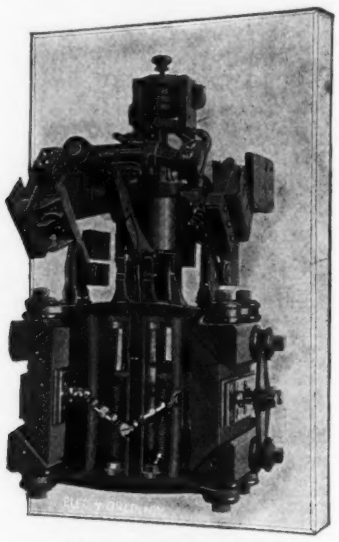
at the rate of 400,000 per day. Beside the presses there are also motor-driven cutting, indexing, stabbing, folding and case-making machines, signature presses, blowers, ruling and sewing machines. The latter are operated by one-sixth-hp Crocker-Wheeler motors connected through worm-gear reducing motion, giving in some cases a reduction from 1800 to 35 revolutions per minute. The styles of the machines and their locations with reference to the floor posts and to other machines were all important factors governing the methods of applying the motors. The machines had to be studied individually, and the best compromise effected to satisfy the requirements of a simple driving train, compactness, accessibility of parts and so forth. Similar difficulties were encountered in securing the controllers to the machines within easy reach of the machine tenders. Great care was taken to protect the wires from drippings from machines, or from any injury that might befall them due to careless handling of tools by the operators.

The following table shows the number of motors and the horse-power in use at present:

	No. of Motors.	Horse Power.
Crocker-Wheeler motors geared to printing presses	85	272
" " keyed to shaft of printing presses	7	35
" " direct-coupled to misc. machinery	56	78
" " belted	14	144
Lundell motors keyed to shaft of presses	2	10
Bullock motors keyed to shaft of presses	2	10
Sprague elevator tandem drum	1	30
Total in daily use at present	167	579

The machinery in the foundry, carpenter and machine shops is all driven by belted motors.

Before the introduction of the system of electric motors it was the custom to run the presses used during the sessions of Congress by



MAIN CIRCUIT BREAKER.

the pressroom engine, which required the turning of all the shafting in the building, even if only two or three of the presses were running. The foundry and the pressroom had separate engines, requiring separate engineers, whose services are, of course, dispensed with under the present arrangement.

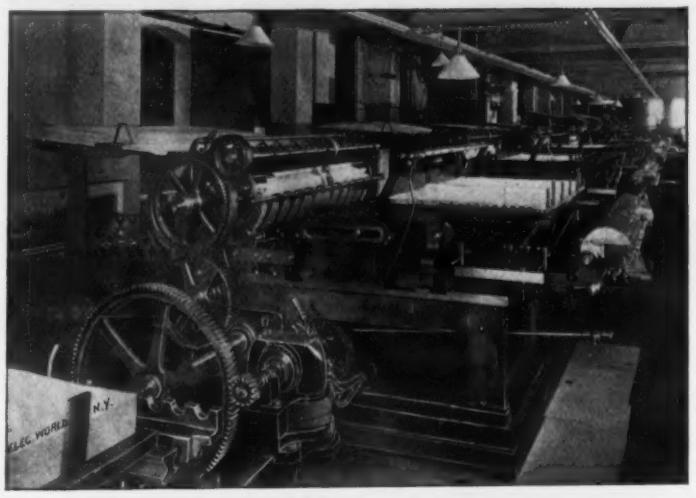
The chief electrician states that "the entire power necessary to do all the work of the office at night, including the running of the large web presses on which the *Congressional Record* is printed, did not amount to within 15 or 20 per cent. of the friction load of the pressroom engine and shafting." This shows at once one of the great advantages of the electrical transmission over the old belt system.

The subdivision of power sources reduces the liability of shut downs to a minimum, and these can only affect a small part of the office.

The electrician is evidently a firm believer in circuit breakers, for he says: "With the introduction into the building of so many motors in so short a period, the turning over of the same into the hands of persons, many of them women, wholly without any experience in the handling of such apparatus, made it absolutely necessary that there be adopted some method of control and protection against carelessness and ignorance."

The old method of fuses as a protection to motors, generators, or of the building itself, was discarded as totally unreliable and dangerous.

A positive and at the same time simple device to accomplish this

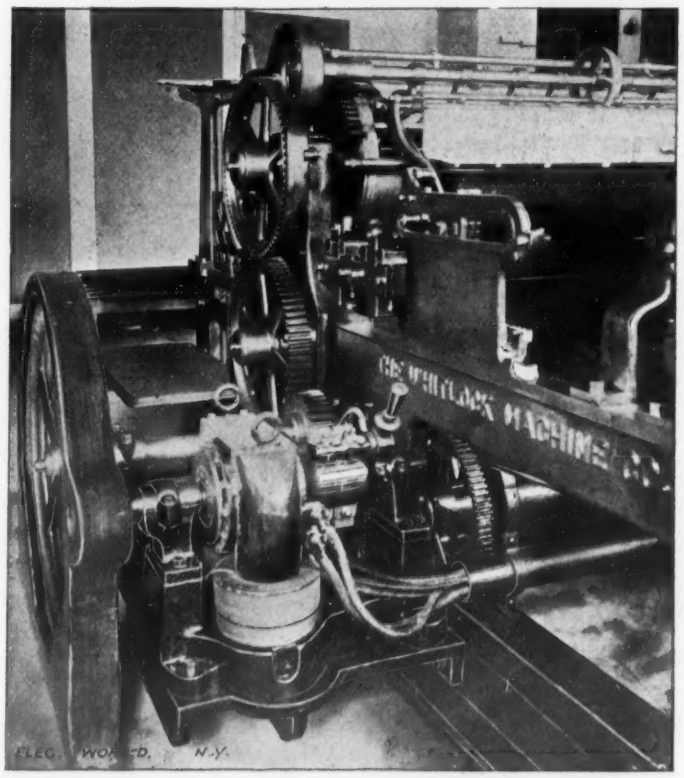


ROW OF CYLINDER PRESSES GEARED TO 5-HP MOTORS.

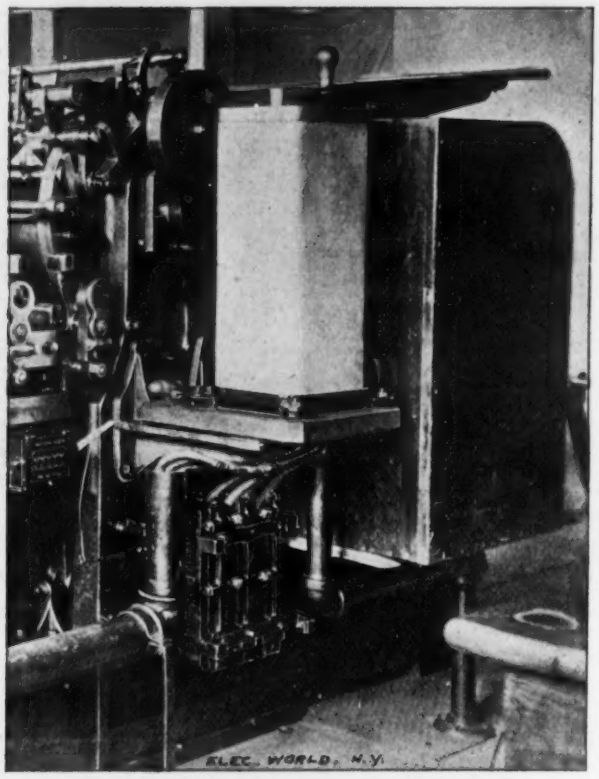
result was desired—something which was governed absolutely by positve forces, not by the fusing of a metal strip incapable of fine adjustment and ready resetting. Such an instrument in the shape of an automatic circuit breaker was found. A long and severe trial proved that it fulfilled all of the exacting conditions. This may be readily shown in the matter of maintenance of the motors. These motors have run more than one year, and not a single armature has burned out (save one belonging to a motor put in on trial) or a field coil given out on one of the motors from one-fourth up to 30 horse-power. Had not the system been amply provided with positive-acting devices which would not allow the improper handling of motors or machinery to which they were attached, the record of repairs for the past year would not have been so slight or the service given so satisfactory.

The connecting of motors direct to the printing presses has more than fulfilled the results anticipated therefrom. Not only has the production been increased many per cent., but the character of work on many of the older presses has been greatly improved, slurring and poor register entirely disappearing. This is largely accounted for by the constant speed of the motor, while with belting there was always more or less slipping.

The amount of current necessary for operating each machine driven by a single motor was carefully ascertained, and the circuit breakers were set to throw if the machine load raised above normal. On one occasion one of the pressmen accidentally had his hand



3-HP MOTOR ON WHITLOCK PRESS, BED 37 X 52.



Controller. Rheostat and Conduits.

caught in the gearing of a press and this caused the machine load to raise above normal; then the circuit breaker instantly stopped the machine and saved him from the loss of his hand. Had the machine been belted to a line of shafting the result would have been quite different.

The motors are all controlled by Crocker-Wheeler controllers, one of which is shown in one of the illustrations, made up much after the manner of the conventional street-car controller, with vertical cylinders revolved by cranks attached to the top of their shafts, and carrying contacts on which the controller brushes bear. The bipolar motors are all rheostatically controlled, the rheostat being cut out step by step as the controller cylinder is rotated. All the motors, both bipolar and multipolar, are cumulatively compound wound, the series winding tending to increase the strength of the field generated by the shunt winding when the machine is acting as a motor. The multipolar machines are arranged with the Crocker-Wheeler commutated field control, whereby various speeds may be obtained when the motor is loaded. This control is effected by means of a series field divided into two sections, one with twice as many turns as the other. On the first starting notch of the controller, the armature current passes through both these sections and a small starting resistance; on the second notch, the starting resistance is cut out; on the third notch, the smaller series field is short circuited; on the fourth notch, the smaller series field is open circuited and the larger series field short circuited; on the fifth notch, both series fields are short circuited and the motor runs as a plain shunt machine. In this way four different speeds may be obtained without the use of resistances.

The plant is run with great system and thoroughness in every respect. The water for the boilers is metered, and the coal weighed, so that accurate figures are obtainable as to the amount of coal required for converting a given quantity of water into steam.

The chief electrician has a recording voltmeter in his office, and this with the readings of the ammeters, made every fifteen minutes, enables him to determine with great accuracy the daily output of the plant in kilowatt hours. This is checked by a wattmeter. The readings are so carefully taken at the proper intervals that the results

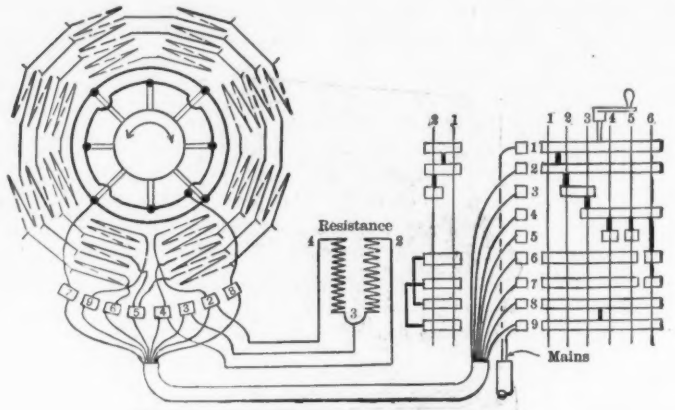
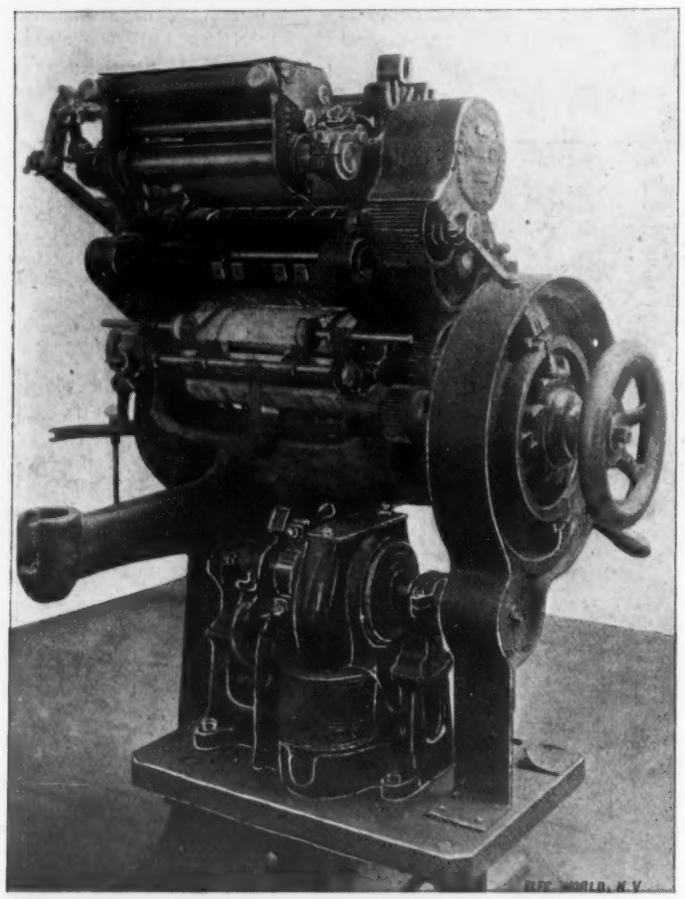


Diagram of Controller Connections.

computed from these readings of the ammeters and the recording voltmeter agree with the wattmeter within 2 per cent.

For the information in this article thanks are due Mr. F. W. Palmer, the public printer, as well as J. M. Stewart, architect of the new power house, and Mr. Collins, the chief engineer, and more especially Mr. W. H. Tapley, the chief electrician. This gentleman gave a large part of his time for many days, going over the plant in detail and furnishing many important items of interest, drawings, specifications and reports of officers connected with the installation of the new light and power plant.



½-hp Motor Geared to Harris Envelope Press.

The Isolated Plant of the French Government Printing Office.

To improve the lighting and sanitary conditions of the national printing office of France, and to reduce the cost of light below that of the gas now used, an isolated electric plant has been installed. This consists of four Charon gas engines of about 45 horse-power each, driving by belts four four-pole direct-current 110-volt dynamos. A battery of accumulators is provided containing sixty-one cells, with a capacity of 1050 ampere hours, each cell containing forty-eight plates, weighing about 10 pounds each; 2500 lamps are supplied on this system.

Travel Reduced by the Telephone.

The president of one of the railroads in the Vanderbilt system, operating between New York and Chicago, is reported to have stated that the noticable reduction in the passenger business can only be accounted for on the supposition that the long-distance telephone is being largely used by business men in place of personal visits.

The Three-Phase Plant of the Tide Water Oil Company.

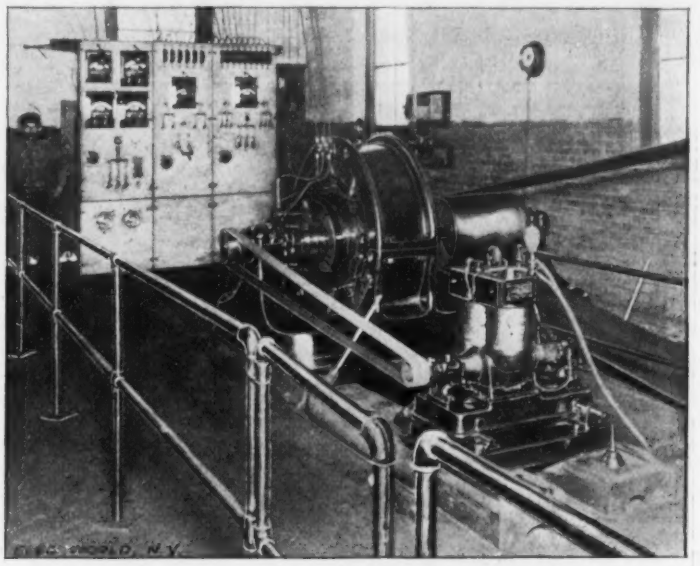
AT Bayonne, N. J., on the Kill von Kull, is situated the oil refining works of the Tide Water Oil Company. Here, in a yard covering about 100 acres, crude petroleum is received from the Pennsylvania oil fields through a pipe line 300 miles long and 6 inches in diameter, capable of delivering some 10,000 barrels per day. This crude oil is distilled, refined and barreled or canned for shipment, or pumped directly into the holds of oil tank steamships. The capacity of different parts of the works is of surprising magnitude. In the accompanying initial letter is a view of one of the agitators, 32 feet in diameter, 80 feet high, and capable of holding 260,000 gallons of oil.

Owing to the inflammable nature of the material worked with, it is necessary to generate power in many places where the slightest spark would be likely at any time to start a serious conflagration. The method in use for many years was the distribution of steam from four or five boiler houses scattered through the works, to engines placed at the points where power was desired. This involved a serious loss by condensation, but no better system was available until the development of the induction motor made it possible to transform electrical into mechanical power without the slightest possibility of sparking.

About two years ago a small multiphase power distribution system was put in, and its work has been so highly satisfactory that the officers in charge are enthusiastic in its praises. The problem is somewhat different from that of long-distance transmission plants in which multiphase machinery is generally used, as the greatest distance of transmission is only some 2000 feet.

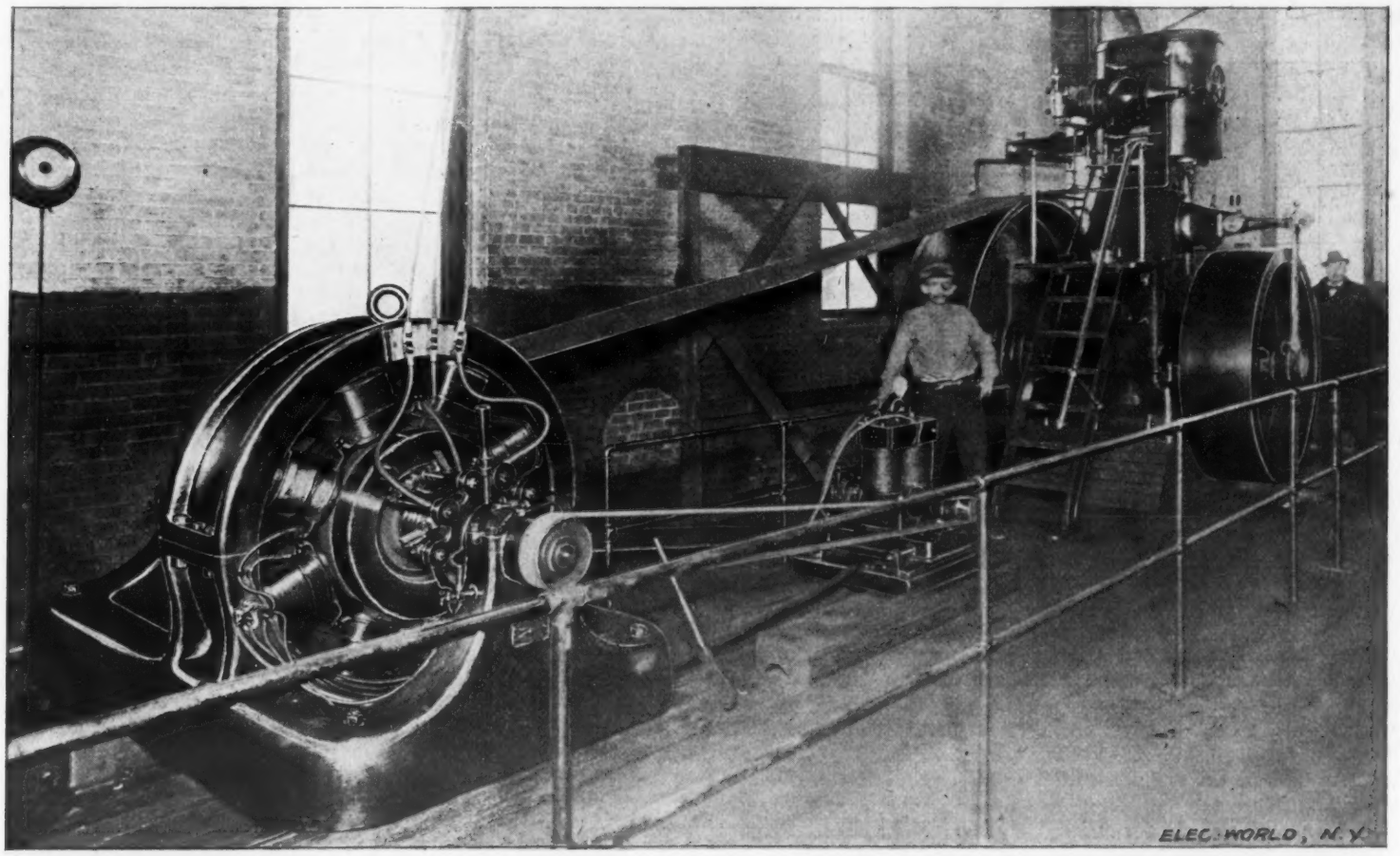
The generating plant consists of an upright American engine, built by the American Engine Company, of Bound Brook, N. J., with cylinder dimensions 15 x 15 inches, generating 150 horse-power at 180 r. p. m. The engine is fitted with a piston valve and Spalding valve motion, by which a reciprocating rotation of the valve rod and valve is superposed on the ordinary valve motion, the angular advance of the rotation being controlled by the shaft governor, thereby giving the action of a double valve with but one valve and valve stem.

Belted to this engine is a 75-kw 8-pole 60-cycle General Electric three-phase alternator, to which in turn is belted a 3-kw bipolar Edison type exciter. The switchboard is practically as simple as that of any alternating plant. It is built up of three marble panels,



THREE-PHASE DYNAMO AND SWITCHBOARD.

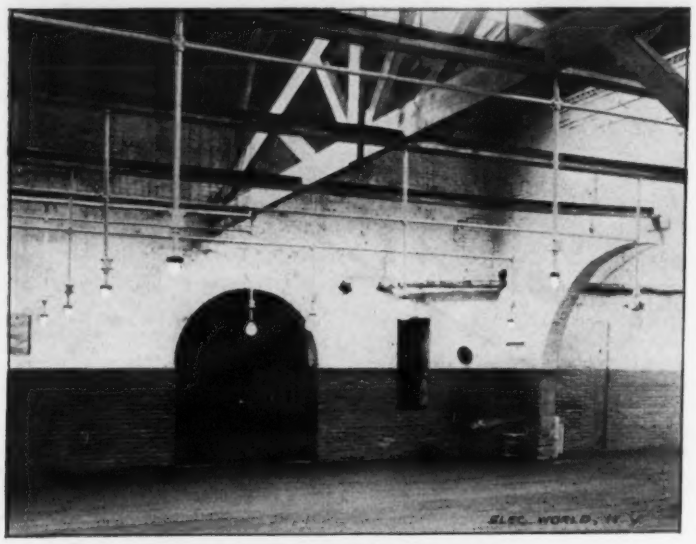
one of which is the generator panel, fitted with a three-pole single-throw main switch, exciter and field rheostats, and three T.-H. current indicators, one in each of the three main leads. On each of the three panels is a T.-H. voltage indicator, equipped with a three-position plug switch, by which any one of the indicators can be thrown on any one of the three sides of the system. A ground detector is also fitted with a plug switch, by which its primary can be connected between the ground and any one of the three main bus bars. Six circuits run from the power house to the different parts



MAIN ENGINE, DYNAMO AND EXCITER.

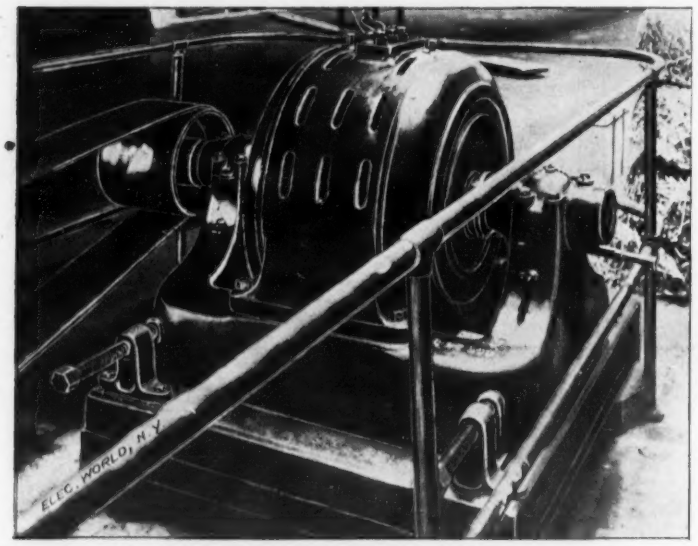
of the yards, the power house being at a nearly central point. Three of these circuits are two-wire for lighting purposes only, and the other three are three-wire for both lighting and power. The machine and line voltage is 550 volts between any pair of the three lines. For lighting service single-phase transformers are mounted on the different buildings and connected across any two of the three wires, ordinary care being taken that the various transformers shall be fairly uniformly distributed between the three sides of the system.

Fifteen motors are in use, the largest of which is 30 horse-power



Air-Tight Distribution System.

and the smallest 2 horse-power, the aggregate capacity being 129 horse-power, besides which some 1600 lamps are wired to the circuits. The motors drive hoists, pumps, boiler shop, tramway, carpenter shop, and do a variety of other work. They are all of the General Electric manufacture, and of the induction type, with primary fixed circuits and secondary rotors. In positions where an inflammable mixture of oil vapors and air is not likely to exist, the rotors are fitted with an internal starting resistance which may be short-circuited by a hand-lever acting through a collar on the



30-hp Induction Motor.

motor shaft For more dangerous positions the short-circuited secondary winding, pure and simple, is used; such motors being fitted with clutches or tight and loose pulleys, so that they may be started without load. They are, however, guaranteed to start with 10 per cent. of the full rated running torque. The largest motor, 30 horse-power, drives by a belt four hoisting drums, which are used for loading and unloading ships at the wharf, pulling cars up and down the wharf, and for various purposes for which a strong pull is desired.

All the motors are equipped with switches operating under oil, the switch consisting of a small three-part commutator capable of rotation from a position in contact with diametrically opposite brushes to an intermediate position of open circuit. The motors are fused in boxes placed outside the buildings.

Of the lighting system, the equipment of what are known as the can-filling and freezing rooms is the most interesting. In the former, rectangular oil cans are filled up by two machines at the rate of 48,000 per day, and spread out on the floor of a large room about 80 x 100 feet in size, where they are allowed to lie for a short time while being watched for leaks. A strong light is necessary in this room, and, as shown in the accompanying illustration, a forest of piping descends from the ceiling to a height of about 8 feet from the floor, where incandescent lights are placed at intervals of about 8 feet in every direction. Ninety-seven lights are used in this room, each mounted in an air-tight inclosing globe on the extremities of the heavy gas pipe conduits. Just above each lamp there is inserted in the pipe a cast-iron box with a bolted cover, in which is placed a bug cut-out. Rubber-covered wire is used, each wire of the circuit being also further inclosed by an insulating tube within the gas pipe protection. In this way all possible danger of a spark occurring in the open air is avoided.

At the time of a fire which occurred in one of these rooms, the building was closed up and filled with live steam until the fire was practically smothered, when openings were made through which nozzles were directed and the balance of the fire drowned out. The lights burned steadily through and after this treatment.

The yard is thoroughly equipped with a 30-station Gamewell fire-alarm system and a Strowger automatic telephone exchange, with twenty-five instruments.

In the two years during which the multiphase system has been in operation the generating machinery has been run twenty-three hours and forty minutes out of the twenty-four hours, 365 days in the year, and has never been shut down for any trouble whatever in the electrical system. The operation has been so satisfactory and the cost of power so greatly reduced over the old system, that it is the intention of General Superintendent F. W. Edwards and Joseph E. Morse, engineer in charge of the works, to extend the system by the addition of another engine, dynamo and more motors.

The Relations Between the Customer, Consulting Engineer and the Electrical Manufacturer.*

I shall endeavor in my remarks to call attention to certain causes of friction which at present exist between the parties in interest, and to suggest certain remedies which may serve to bring about a better understanding and to lessen this friction, which is, in my opinion, entirely unnecessary.

About twelve years ago electric lighting was still an experiment (from the commercial standpoint), electric railroading had not begun and electric power transmission was discussed as one of the possibilities of the future. Very few of our institutions of learning had established separate electrical courses and such a thing as a consulting electrical engineer hardly existed in this country. The few men who had some theoretical knowledge were eagerly caught up by the manufacturing companies, who had difficulty to find men capable of solving the many pressing practical problems with which they were confronted when they began to sell electric machinery.

Doubtless most of those present can recall the remarkable growth of electric lighting and railway work during the next five years, from 1887 to 1892, a growth that can fairly be called tropical. Plants sprang up in nearly every city and town in the country, and manufacturers sprang up with equal rapidity. There seemed to be unlimited money ready to invest in electrical enterprises, and the anticipated profits were such as to make the old established manufacturing industries seem very poor investments. During this period, which may be called the "forced expansion period," purchasers usually had to take what they could get and consulting engineers were few and far between. By the close of this period, however, the colleges and technical schools began to turn out men who had taken special courses in electricity and who naturally looked for a chance to make an honest living. The first great demand of the manufacturing companies for technical assistants having been satisfied, many of these young men found their way into local operating companies, or else established themselves as consulting or contracting engineers, in which positions they found plenty of work; for by this time the

*Abstract of paper read by S. Dana Greene, before the New York Electrical Society, January 12, 1898.

imperfections in the earlier installations and types of apparatus had become plainly evident, to the purchaser as well as to the manufacturer.

In 1893 came the panic, and for the past four years there has been a wonderful record of savings and economies, both in electrical manufacturing and operating companies, as well as a great improvement in quality of product. It has been, in fact, the "economic and reconstruction period." The business to-day is on much the same basis as in other industries where prices are close, competition keen, and where a better article is furnished for less money than ever before.

The manufacturers of apparatus and the manufacturers of current are dependent upon each other to a large extent, and their relations should be close and friendly. The consulting engineer, as in other engineering trades, is a necessary and proper connecting link between the two, and I can say frankly that I believe he has a proper and permanent field of usefulness. Broadly speaking, his function is to see that his client who buys apparatus and installs it selects first that system best suited to his particular local conditions, and then, in purchasing, secures the best (not necessarily the *most*) for his money. It is equally the duty of the consulting engineer to learn what the manufacturer can reasonably be called upon to make, to consult with him freely and to obtain the benefit of his experience; to give him credit for work well done and to insist that bad work shall be promptly corrected. Many consulting engineers, especially those who have recently commenced practice, seem to think that it is improper for them to consult with the manufacturer, or to examine his plant or to ask him for information or advice. The inevitable result is that specifications often contain provisions which are a source of annoyance and expense to the manufacturer and purchaser alike, and which have no compensating advantages. In fact, some of these provisions are impossible or impracticable of fulfillment; and in such cases the honest manufacturer who wishes to meet the specifications and guarantees required, finds himself forced to ask the engineer or the purchaser (sometimes both) to modify them. This is a proceeding which is always difficult and delicate to undertake and often results in friction and trouble for all concerned. I am satisfied that if every consulting engineer would take advantage of opportunities as they occur, to visit manufacturing establishments, see the work there in progress and confer with the engineers, he would find himself well repaid for the visit, and his own work and practice be benefited thereby. I am equally satisfied that no reputable manufacturing establishment would refuse admittance, but on the contrary would welcome such visits as beneficial to both parties. The day of mysterious methods of manufacture carried on behind closed doors is passed in the electrical business, and I appeal with confidence for an endorsement of the opinions just expressed, to those consulting engineers who have already tried the plan suggested.

Some engineers seem to measure their value to the purchaser by the length of their specifications, and some of these formidable documents strike terror to the heart of a busy man confronted by a deskful of mail. The specifications not only specify what the conditions of service are, what apparatus is required, and what tests shall be applied to it for acceptance, all of which are quite proper; but also *how it shall be built*, which is another matter. The electrical manufacturers of this country, following the admirable precedent which has given American manufactured products (particularly machinery) a world wide reputation, have endeavored to establish *standard* lines of apparatus, whenever the permanency of type and the size of the demand warrant it. This practice not only tends to reduce cost (and with it price), but also enables the purchaser to secure quickly and at a minimum of expense, duplicate parts which are really duplicates and which can be fitted without the aid of a skilled mechanic. This system is possible only where the same article is manufactured in quantity, since the expense of designs, drawings and patterns, special tools, jigs, dies, etc., is prohibitive unless spread over a large production. It would appear to be to the interest of both seller and buyer to use such standard machines wherever and whenever possible; and yet it seems to be a fact that the demand for special machines is increasing, rather than decreasing, as apparatus becomes more generally standardized. To prove this I can cite the experience for the past year of one manufacturing company, with which I am familiar. During this period the designing engineers were called upon for estimates on *special apparatus*, as follows:

Direct Current—Number of estimates, 300. Number of kilowatts of apparatus involved, 31,000.

Alternating Current—Number of estimates, 300. Number of kilowatts of apparatus involved, 131,200.

This was in addition to their regular work on standard lines of apparatus, of which there are over thirty. Some of this work was undoubtedly due to new developments in the business, and to new methods and inventions, a condition which, although unfortunate from the manufacturing standpoint, must exist for many years to come; but a great deal of it was also due to the fact that specifications call for special apparatus, or methods of construction, where standard apparatus and methods would do equally well.

Another phase of the subject is the tests and guarantees prescribed by specifications. Omitting from consideration matters which, as already stated, belong properly to the designer and builder, such as current densities in the windings or in brushes, methods of insulation, kinds of material, etc., etc., the tests necessary to determine a machine's quality (and hence its value to the purchaser) are few in number and can be enumerated under the headings of *efficiency*, *heating*, *regulation*, *sparking* and *insulation*. If the requirements under these five headings were formulated under some general rules, and if the methods of tests to determine results were uniform, the work of the consulting engineer and the manufacturer would be vastly lessened. It seems practically impossible for the various manufacturers and consulting engineers to standardize these requirements and tests by any concerted action, and the only other solution of the difficulty is for some scientific, non-partisan organization to undertake the work. The American Institute of Electrical Engineers is just such a body, and it would render a great service to the entire electrical business if it would consider the matter. Without attempting in any way to suggest what action it should take, it seems proper to call attention to some of the points which most frequently give rise to misunderstandings and disputes.

1. *Efficiency*—The proper distinction between electrical and commercial efficiency is not made. The latter is what interests the purchaser, and it should always be specified. A clear statement of what losses must be included to determine it, also a general statement of what constitute reasonable and proper commercial efficiencies in well designed machines, would be of great service. Such a statement should show the necessary differences between carbon and copper brushes, and between the voltages most commonly used in direct-current work, viz., 125, 250 and 500 volts, as well as between machines of various sizes. The formulation of such information on alternators is more difficult, but all manufacturers have certain standard lines of these machines and it is quite possible to make some intelligent general rules.

Electrical manufacturers are sometimes required to guarantee the *combined* efficiency of generator and engine (or other prime mover). This is clearly unfair and shifts the direct responsibility of guarantee from the maker of the prime mover, where it properly belongs.

2. *Heating*—For all ordinary conditions of service, the safe heating limits for continuous full load operation can be determined with a fair degree of accuracy. The commutator heats more than any other part of the machine, particularly with carbon brushes, a fact which is often ignored. Sometimes the heating is measured by thermometer, sometimes by increase in resistance. There should be one uniform method followed. Overload guarantees (ranging from 25 per cent. to 100 per cent.) are sometimes required for a period within which the ultimate temperature of the machine is reached, and the necessary capacity of the machine is thus increased as certainly as though a larger machine were specified.

3. *Regulation*—Specifications frequently call for a straight line compounding curve, a condition which is practically impossible until we discover a magnetic material which has a straight line saturation curve. Another common requirement in the case of lighting generators is that a drop of say 2 per cent. in speed shall not affect the E. M. F. more than 2 volts, which is also an impossible condition, even with a separately excited generator.

4. *Sparking*—Modern design, and the use of carbon brushes, have greatly reduced the trouble from sparking, but machines are sometimes called upon to stand excessive overloads without sparking, which can be accomplished only by using a larger machine or by a distortion of design, which is bad practice. Any good machine, with carbon brushes, should be able to stand a variation from no load to full load without movement of brushes and without noticeable sparking; it should also stand a reasonable overload, say 25 per cent., without injurious sparking.

5. *Insulation*—This is a cause of frequent trouble and annoyance.

The common practice is to specify an insulation resistance of so many megohms, regardless of the size of the machine and the voltage and conditions of service. Considering the fact that this resistance varies inversely as the area of surface to be insulated, and considering the enormous variations in size, shape, voltage and service requirements of different machines, it is evident that such a test is impracticable and means little or nothing. Insulation resistance is largely a question of dryness, and if an armature be baked for a sufficient length of time almost any resistance within reason can be obtained. I have known a large 400-kw lighting armature to measure a megohm resistance, as required by specifications, after several days' baking (which, by the way, permanently injures the structural strength of the insulating material), and yet it showed practically no resistance when it reached its destination, because it had been in the rain and dampness for a week or more, and the large surface naturally afforded an excellent lodging place for moisture. A day's run in a weak field, with the armature short circuited, quickly brought the insulation up again.

The only proper way to insure good insulation, with reference both to the material used and the method of construction employed, is by a *high potential* test applied when the machine is reasonably dry. This test should be intelligently gauged by the voltage of the machine and the service required. Thus a high potential test of 1000 volts is ample to detect any insulation weakness in a 125-volt lighting generator, while a 5000-volt test is ample for a 1000-volt alternator, allowing proper factor of safety in each case. Recent careful investigations have developed the fact that the only correct way in which to determine the proper high potential test for any given machine is to consider jointly the time duration of test, the current frequency and the voltage of machine. As the latter rises, the margin between it and the test voltage necessarily decreases on account of the liability to permanent injury of the insulation when subjected to excessive voltages. Because 5000 volts is found to be a proper test voltage for a 1000-volt machine, it by no means follows that 50,000 volts is proper for a 10,000-volt machine, or that the apparent factor of safety should be the same as the voltage rises.

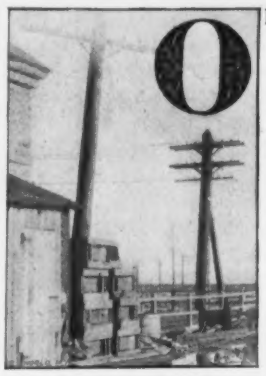
We come finally to the commercial requirements which have gradually found their way into specifications, and which are sometimes onerous and unfair. Perhaps the most important of these is the question of shipments. It is not uncommon for shipment to be specified by a certain date, under a forfeiture of so many dollars a day for each day's delay thereafter, and the award of the contract is often largely affected by such promises. The manufacturer starts the work in his shops and if the time is short he is apt to work overtime. About the time the apparatus is ready for shipment, and without any previous warning, word comes to withhold shipment because the purchaser is not ready to receive it. There were recently fifteen carloads of apparatus lying in the yards of one of our manufacturing establishments, besides a number of large machines stored in the shipping and testing departments, which had been made on time contracts and held at the last moment by request of the customer. It is difficult for one not in this end of the business to realize the resulting demoralization throughout the shops, and it is a condition which could easily be remedied by the exercise of more foresight on the part of the purchaser and his engineer. In all cases where a penalty of delay in shipment is imposed, it is fair and reasonable to ask that a similar bonus should be awarded if shipment is made in advance of promised date, or if the purchaser is unable, through no fault of the manufacturer, to receive the apparatus on that date. It is sometimes required that the consulting engineer shall have free access to the shops at all times while the apparatus is in production. Such permission is impracticable if proper shop administration and discipline are maintained, and these visits should be made at certain specified stages of the work. It is, of course, always proper for an engineer to be present when the apparatus is finally tested.

A clause is commonly found in specifications providing that the consulting engineer shall be sole judge of the true intent and meaning of the specifications; and in case of any dispute thereunder his decision shall be final and binding. It is true that this clause is common in architects' and builders' contracts, but it is doubtful whether it could be enforced at law, in case of a dispute as to facts, and it certainly seems fair that in case of such a dispute, where the two parties honestly disagree, provision should be made for a third disinterested party to act as arbiter.

In conclusion let us hope that the customer, the consulting engineer and the manufacturer will, in the future, consult each other more freely and frankly, by personal interview or by correspondence.

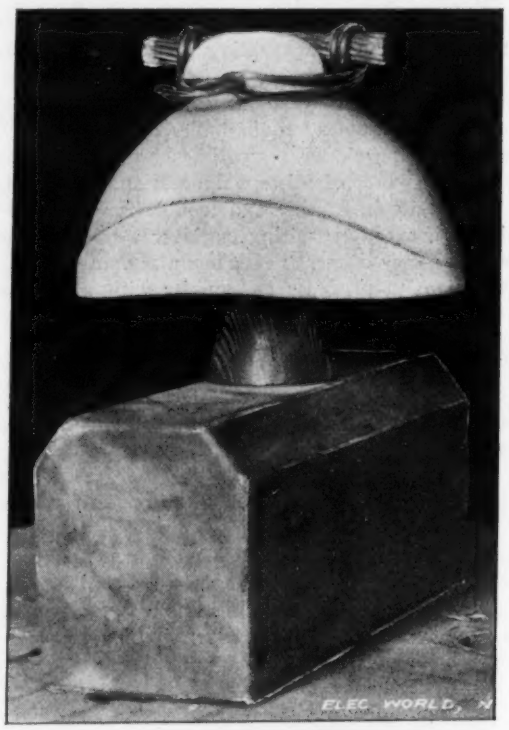
The Testing of Insulators for High Tension Service.

BY J. R. HASKIN.



OF the many things to which careful attention must be paid in the construction of a long-distance line for the transmission of electricity at high pressure, one of the most important, if not really the most important, is the proper testing of the insulating devices. Unless each insulator is thoroughly capable of withstanding the pressure and strain to which it is to be subjected when in service, there will necessarily be one or more unknown weak spots, which by their breaking down will necessitate the discontinuance of service until, after more or less trouble and delay, the particular location of the trouble is found. Too much attention therefore cannot be paid to the thorough testing of the insulators before installing them.

When the Niagara-Buffalo transmission line was about to be constructed, the question of insulation received very careful attention from the electrical superintendent of the company, Mr. Paul M. Lincoln, who after careful deliberation designed two transformers, each capable of producing a pressure of 20,000 volts. The primaries of these transformers, which are connected to a 110-volt circuit of 25



Cross-Arm, Pin, Insulator and Cable, Niagara Line.

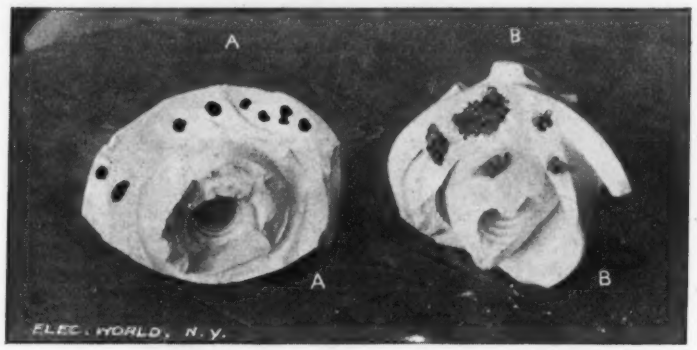
cycles, consist of a number of turns of No. 10 cotton covered wire, while the secondaries are made up of ten coils of No. 30 silk-covered wire, each having a ratio of 20 to 1 to the primaries, thereby giving a pressure of 20,000 volts in each transformer when its secondary coils are connected up in series. One of these transformers is equipped with a small plug switchboard, to which is connected a lead from each of the secondary coils, by means of which the voltage used for testing may be varied from 2000 to 20,000 volts.

Shortly after the transformers had been completed, a number of barrels of insulators arrived, and it became necessary to put them in use at once. The transformers were mounted in wooden boxes, which were afterward enclosed in a tin casing in order to make them oil tight, and in order to thoroughly insulate them they were submerged in a thin oil. Except for breakdowns in one or two of the secondary coils, due to faults in the winding by which two sections of wire having a considerable difference in potential came in contact with each other, no trouble was experienced with the insulation, the transformers being protected from overload and the consequent possible burning out by fuses placed in the primary circuits. For con-

venience, it might be added, that small double pole switches and pilot lamps were furnished to each transformer in the primary circuits, these, together with the main switches, checking each other and acting as safeguards to the operator.

The manner of testing the insulators may be briefly described as follows: The insulators were placed in an inverted position in a square iron pan capable of holding a dozen or more; the pin holes were filled up half full with salt water and the insulators were also submerged in the same to within about an inch of the edge of the outer petticoat. One lead from the transformers was attached to the pan and the other to a short bar of zinc or copper, this being placed in the pin hole of each insulator in turn.

During the early tests a pressure of 20,000 volts was first applied, and if the insulator stood this test the pressure was gradually increased to 40,000 volts, but after the first few had been tested it became customary to apply the entire 40,000 volts pressure at once. If the insulator is satisfactory, nothing will be noticed except a subdued humming sound caused partly by the transformer and partly by the discharges due to a condenser action on the surface of the insulator, with ofttimes a snapping blue, static spark jumping from the edges of the pin hole to the outer petticoat edge of the insulator, this latter phenomenon generally appearing when the surface of the insulator is at all moist or has upon its surface a few drops of the salt water accidentally spilled upon it. But if there is a slight flaw in the make-up of the insulator a yellowish spark will imme-



A.—INK SPOTS ON GOOD PORCELAIN.
B.—INK SPOTS ON POOR PORCELAIN.

diately manifest itself, and if the breakdown is at all serious this spark may be seen coming through the top surface of the inverted translator, below the level of the brine. And right here is where the advantage of having salt water becomes evident, as will be shown later on.

When the first lot of insulators arrived there was urgent need of haste on account of contracts in Buffalo, which it was necessary to fill at a certain date. So when on testing these insulators it was found that a very large proportion of them failed to pass the above mentioned test, in spite of the fact that they had been tested by the makers before shipment, it was urged by the contractors that the test was too severe. Experiment showed that when fresh water was used instead of brine, a much larger proportion of the insulators passed the test and were apparently sound and well made. It is rather difficult to say why this should be, but the fact remained nevertheless. A few days later, however, another lot of insulators having arrived from another manufacturer, it was found that a very fair proportion of them stood the test with brine satisfactorily, and it was then decided that the test was none too severe. Owing, however, to the necessity for haste in the equipment of the transmission line, the first lot was tested with 20,000 volts only, with the proviso that these should be replaced as rapidly as possible with other and better insulators. It is a curious fact that out of 1000 of these insulators which were tested again after having been in service but a month or two, all but one broke down.

Regarding the test said to have been made on these insulators by the manufacturers, it was learned on inquiry that they had been merely set in a row while still warm from the kiln in which they had been baked, and touched on the outside and inside with the terminals of a transformer giving 40,000 volts pressure. The reason for their poor insulating properties was easily made apparent by breaking up one of the insulators and examining the porcelain, which was found by the application of red ink to an unglazed surface to be very porous. In nearly every case also, flaws caused by imperfect kneading of the clay were found, poor lots of insulators being often filled with these imperfections, while only one or two flaws would be found in the imperfect ones from a lot which gave a high percentage of satisfactory insulators.

Too much importance cannot be given to this matter, as it is above all the prime requisite of a porcelain insulator. A perfect piece of porcelain ,three-sixteenths of an inch in thickness, is for all practical purposes non-puncturable. For example, a number of small insulators, measuring but 2 or 3 inches in diameter, were brought to Mr. Lincoln's office by a representative of a well-known firm, with a request that they should be tested to their full capacity. This capacity proved to be about 30,000 or 32,000 volts, it being impossible to raise the pressure any higher, owing to the fact that a spark would jump over the surface of the insulator when using the rather crude form of apparatus which was designed for the testing of much larger insulators. These insulators were less than three-sixteenths of an inch in thickness in some parts, but on breaking them open they were found to be of good porcelain and without a flaw.

The necessary size of the insulator to be used appears to vary somewhat according to the climatic conditions of the locality in which they are to be installed. The writer has been informed that in certain sections in the West where the climate is very dry and the air thin, power has been and is now being transmitted at a pressure of 50,000 and 60,000 volts on wires insulated only by the ordinary glass insulator in common use by the telegraph and telephone companies. In such a locality as Niagara Falls this would be impossible, as the moisture and dust collecting on the surface of the insulator would be sufficient to allow the current to leak across even when but 10,000 or 15,000 volts were being used. Therefore, a large insulator made of the first quality of porcelain, well baked and vitrified, is the only one that will stand the pressure and wear of a high tension transmission line in such a locality.

There are a number of types which might be used to advantage, two distinct ones being in use on the Buffalo transmission line, one being round and having a triple petticoat, the other being what is known now as the Niagara helmet type insulator, the name of which very fully explains its shape. This latter has also a triple petticoat, and is besides furnished with a small gutter on the two sides, arranged in such a way as to lead off dripping water to the ends where it may fall clear of the cross arm.

So important is the quality of the porcelain in the making of a good insulator that I am tempted to give the result of several other experiments which we made on this subject during the period occupied in turning out insulators for the transmission line. One lot of samples sent for test by a large manufacturing concern was made up of several parts or layers, each layer having been formed, baked and glazed separately and the various parts set together and again baked, the glaze uniting them into one solid insulator. While the porcelain of these insulators was found on examination to be full of flaws it was claimed that having been made up in separate parts, these flaws could not go completely through the body of the insulator, and furthermore, the various layers of glaze acted in favor of the insulating qualities; but after soaking several of these samples in a solution of salt water for several days, it was found that everyone of them broke down at a considerably less pressure than 40,000 volts. On examination it was discovered that the porcelain was so porous that it was—one might say—water logged.

Many other sample lots were found to have this defect also, it being often readily discernible upon an application of red ink to an unglazed surface, the red ink showing clearly all cracks and porous parts of the porcelain. In every case it was found that a good quality of porcelain insured a high percentage of satisfactory insulators and *vice versa*.

In conclusion, no better proof of the satisfactory nature of the test above described can be given than the working of the overhead system of the Buffalo transmission line since the commencement of its operation. Except for a few cases of breakdown among the insulators that had been installed temporarily, it has been necessary to remove only two or three insulators out of the whole set of more than 12,000.

An Imperial Inventor.

According to our London contemporary, the *Electrical Review*, it appears that Emperor William of Germany is to decide what system of electric traction shall be adopted at Berlin, and that it is highly probable that he will not select any of the systems, but will invent a new one, provided he has time to do so.

Alternating-Current Machinery—XXIII.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

ALTERNATORS.

191. Alternating-current generators, or alternators, may be divided into classes according to:

(a) The type of current produced; *i. e.*, whether single-phase or multiphase;

(b) The type of field employed;

(c) The type of armature employed;

(d) The method of driving.

(a) Considering first the type of current produced, machines may be either

(1) Single-phasers or uniphasers,

and (2) Multiphasers or polyphasers.

Multiphase machines, or multiphasers, may be sub-divided into

(1) Two-phase or quarter-phase machines.

(2) Three-phase machines.

(3) Monocyclic machines.

(b) Considering the type of field employed, machines may be either

(1) Machines with a rotating armature and a fixed field.

(2) Machines with a rotating field-frame and a fixed armature.

(3) Inductor generators, or machines in which neither a field winding nor an armature winding is revolved.

(4) Induction generators in which a rotating magnetic field is produced by external excitation.

(c) Considering the type of armature employed, we may have:

(1) Machines with pole armatures.

(2) Machines whose armatures are provided with distributed windings.

(3) Machines with radial or disc armatures.

(4) Machines with drum armatures.

(5) Machines with ring armatures.

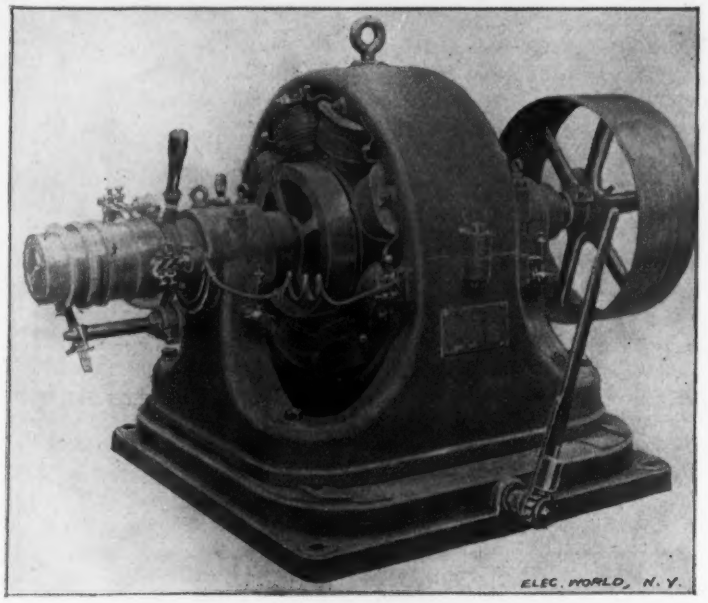


Fig 132.

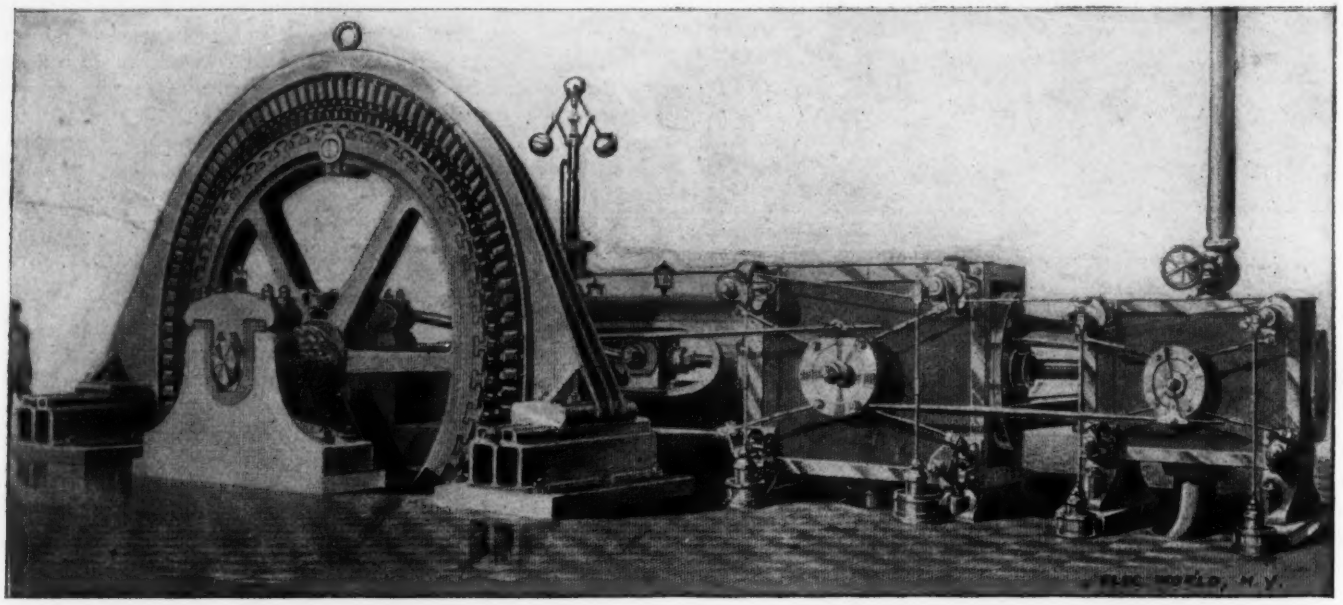


Fig. 133.

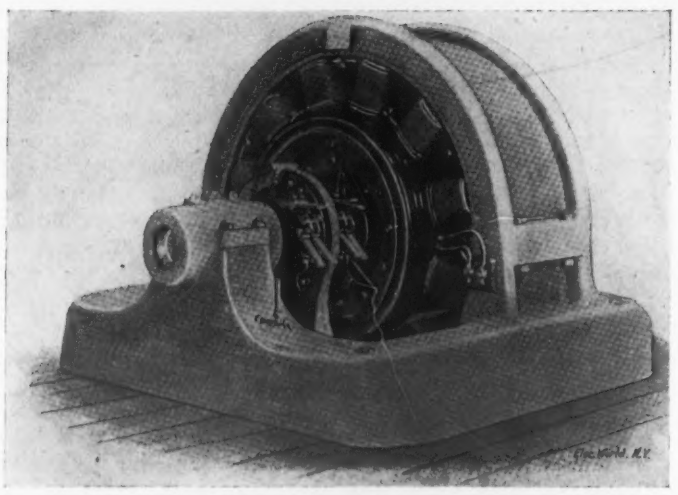


Fig. 134.

(d) Considering the method of driving, we may have:

(1) Belt-driven machines.

(2) Direct-driven machines.

192. Alternators are constructed to supply a variety of frequencies, ranging from 25 cycles per second (3000 alternations per minute) to 140 cycles per second (16,800 alternations per minute). Until recently, the types of machines built in the United States were those which supplied the higher frequencies. At the present time the tendency is in favor of the lower frequencies, usually about 60 ~ per second, or 7200 alternations per minute.

193. All of the alternators constructed in the United States are multipolar machines, the number of their poles being determined by the frequency and by the speed of revolution of their armatures. Thus, if the rate of alternation is say 16,000 alternations per minute, and the alternator rotor, or revolving element, is driven at a speed of say 800 revolutions per minute, then the field frame must contain $\frac{16{,}000}{800} = 20$ field poles. The number of poles in the field frame must, of course, always be even, since otherwise two adjacent poles would necessarily have the same polarity.

194. As an example of a single-phase machine, Fig. 132 shows a Westinghouse 60-kw alternator. It has eight poles, and its armature is driven at a speed of 900 revolutions. Consequently, its frequency or periodicity is $8 \times 900 = 7200$ alternations per minute, or 60 cycles per second. When slow speeds of driving have to be adopted, as for example, when an alternator is directly connected to a slow-speed engine, the number of poles in the field is necessarily increased. Thus, in Fig. 133, the single-phase alternator shown has 112 poles, and is directly connected to a tandem compound Corliss engine.

It will be observed that the machines illustrated in the two preceding figures have each one pair of collector rings, from which the single-phase alternating-currents generated in the armature are delivered to the external circuit.

195. If two or more single-phasers have their armatures rigidly coupled to a common shaft in such a manner that the E. M. Fs. produced in them are out of step with each other, the combination so produced will form what is called a *multi-phase generator*. When two such machines are actually or virtually coupled together, the relative phase angle of their armatures is one-quarter cycle, so that the E. M. F. generated by one armature will be at its maximum when the E. M. F. generated by the other is zero. The two machines so connected would form a *quarter-phase, two-phase* or *diphase generator*. If three such machines are coupled together, the phase difference between their armatures would be made one-third of a cycle. Such a combination would form a *triphase* or *three-phase generator*. If it were desired to produce a machine having more than three phases, say five-phase, it might be done by connecting five armatures rigidly together on a common shaft, and arranging their angular position in such a manner that the E. M. F. in each differed from the next in succession by one-fifth of a cycle. In practice, however, not more than three phases are employed, owing to the complexity of the resulting system of circuits.

196. It is to be observed that the general rule of phase difference between the E. M. Fs. producing an n-phase system is that the phase difference of the component E. M. Fs. is one nth of one cycle,

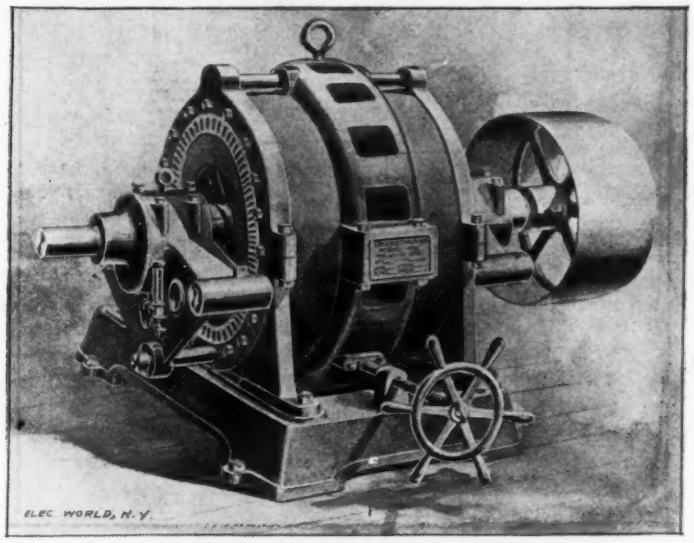


FIG. 136.

except in the two-phase system, in which the phase difference is not one-half cycle, but one-quarter cycle. Two E. M. Fs., differing in phase by one-half a cycle, are two opposing E. M. Fs., or such as would be produced by two-single machines in step, one of which was reversed relatively to the other.

In practice, the plurality of armatures above discussed are rarely employed in multiphase generators. It is both simpler and more economical either to place on a common armature-core a plurality of windings, or to tap a single winding at a plurality of points. In such cases, either the separate windings are angularly disposed, so as to have their E. M. Fs. induced at the proper difference of phase, or the points tapping the armature are situated at such positions as to obtain the phase difference required.

197. An example of a three-phase generator in which the armature is provided with a triple winding, so as to produce the requisite difference of phase, is seen in Fig. 134. This is a General Electric Company's twelve-pole machine. Like all triphasers, it has three collector rings, one for each phase. Diphasers do not differ in appearance from triphasers of the same capacity, except that they are provided with four collector rings, two to each phase. Monocyclic generators have three collector rings, and closely resemble triphasers.

198. The ordinary type of alternator has a fixed field frame and a revolving armature, as represented in Figs. 132, 133 and 134; that is to say, the field magnets form the *stator*, or *staticnary member*, and the armature is the *rotor*, or *rotary member*. Some machines, however, have a rotating field frame and stationary armature, as represented in Fig. 135, which shows a General Electric Company's single-phase alternator, having twelve magnets on an interior revolving frame, and a fixed armature surrounding them.

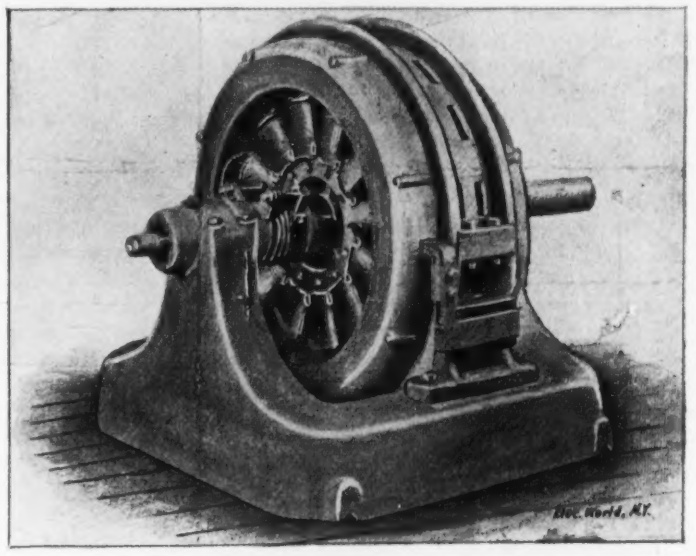


FIG. 135.

199. In the *inductor type* of machine the rotor consists of a mass of soft iron by which the magnetic flux produced by the action of the stationary field coil is passed into and out of stationary armature coils. Fig. 136 represents a form of S. K. C. inductor alternator.

Electricity Direct from Fuel—I.

BY C. J. REED.

After allowing his direct-from-fuel battery to remain in oblivion for more than two years, Dr. Borchers has recently brought it again before the German Electro-Chemical Society in a paper published in *Zeitschrift fur Elektrochemie*, July 20, 1897. He has again set up the claims that were made in 1894 for his carbon-copper battery, which were proven at that time by a number of investigators to be entirely without foundation. He now describes some new experiments, which, however, do not appear to have any bearing on the substantiation of his claims.

There is a very simple experiment, which proves conclusively that in all the batteries described by Dr. Borchers none of the electrical energy was evolved by the oxidation of the fuel-gas he introduced. This experiment Dr. Borchers did not perform, or at least did not report, either in his earlier or in his recent paper. The experiment in this particular case is a crucial test, because the result is negative. It is an experiment which we should expect anyone seeking for the truth would naturally perform first of all in a case of this kind.

One of the simplest methods of determining whether a certain agent is the cause of a certain effect is to determine whether the agent will produce the effect. Where several agents acting together result in producing a certain effect, we may be unable to say which agent is the cause of the effect, or whether it is not caused by the joint action of several agents. But when the effects of all other agents can be entirely eliminated without changing the conditions, and we then find that the agent in question does not produce the effect, we feel reasonably sure that it is not the cause of the effect.

The question Dr. Borchers essayed to determine was whether the air and fuel gases he introduced into his battery were the cause of the electrical energy (amounting to about 0.076 watt) which he measured. The only measurements made by Dr. Borchers to determine

this question were measurements of current and potential difference, and were made only after the gases were introduced. It would not have changed the conditions or results of his experiments if he had taken a measurement of the current and potential difference before, as well as after, introducing the gases. If he had done this, it ought to have materially changed his inferences. If the measurements are found to be the same before and after introducing the air and gases, it is evident that they are not the cause of any effect. If the measurements are found to be different, it is then time to determine whether the effect produced by the gases is due to oxidation or to some other action.

Instead of trying this simple and obvious experiment, Dr. Borchers made measurements on one combination of electrodes and electrolytes, into which he had introduced the air and gas, and on an entirely different combination of electrodes and electrolytes, into which the air and gas had not been introduced. Such an experiment, of course, could determine nothing as to the effect of the air and gas alone.

On account of the wide publicity given to the claims of Dr. Borchers and the prevailing popular impression that the problem of producing electrical energy by the direct combustion of coal or carbon has really been solved; and in view of the fact that some well informed persons, and some whose names are known to science, refer, even to this day, to the experiments of Dr. Borchers as having settled this question, it seems desirable to present to the readers of The Electrical World an outline of the facts concerning this alleged discovery, in order that the reader may draw his own conclusions, instead of being obliged to accept the conclusions of enthusiasts, which are sometimes based largely on imagination.

In the solution of the problem of getting electrical energy directly from the oxidation of carbon and other substances, the maximum E. M. F. obtainable, and the maximum current quantity obtainable from a given quantity of material, depend upon the valence and the combustion heat of an atom of the substance.

The complete combustion of a gram atom of amorphous carbon to gaseous carbon dioxide evolves approximately 96,960 gram-calories of heat. If this energy were all expended in the form of electrical energy instead of heat, the greatest E. M. F. it could develop would be

$$\frac{96,960}{4 \times 23,260} = 1.04 \text{ volts.}$$

If the carbon dioxide were evolved in a solution in which it remained dissolved, its energy would be increased by 5880 units, the solution heat of carbon dioxide, making a total of 102,840 calories. This gives a maximum possible E. M. F. of

$$\frac{102,840}{4 \times 23,260} = 1.10 \text{ volts.}$$

The statement by Dr. Borchers in his first paper that the theoretical E. M. F. of carbon is 2 volts is incorrect, and was probably calculated on the supposition that carbon becomes a dyad instead of a tetrad in the reaction $C + O_2 = C O_2$.

The oxidation of a gram-atom of amorphous carbon to gaseous carbon monoxide, C O, evolves 28,500 calories. If this oxidation could be accomplished by a galvanic process with no absorption or loss of energy it would be capable of producing an E. M. F. of

$$\frac{28,590}{2 \times 23,260} = 0.61 \text{ volt.}$$

The oxidation of a gram-molecule of gaseous carbon monoxide to gaseous carbon dioxide evolves 68,370 calories, corresponding to an E. M. F. of

$$\frac{68,370}{2 \times 23,260} = 1.47 \text{ volts,}$$

as given also by Dr. Borchers.

The oxidation of gaseous carbon monoxide to an aqueous solution of dioxide evolves 74,250 calories, corresponding to

$$\frac{74,250}{2 \times 23,260} = 1.59 \text{ volts.}$$

Although carbon monoxide in oxidizing to the dioxide gives about 50 per cent. higher E. M. F. than that given by carbon, it must be remembered that the electro-chemical equivalents are so related that the quantity of current corresponding to the oxidation of one atom of carbon, corresponds to the oxidation of two molecules of carbon monoxide.

If gaseous carbon monoxide, instead of carbon, be taken as the original fuel, there is a necessary loss at the outset of

$$\frac{28,590}{96,960} = 29.5 \text{ per cent., leaving } 70.5 \text{ per cent. as}$$

the highest possible efficiency of any subsequent process.

These calculated values of E. M. F. are possible only on the supposition that the reaction evolving electrical energy liberates all the energy of the combination as electrical energy, and that none is absorbed in the formation of by-products.

The battery described by Dr. Borchers in 1894, upon which his sensational claims were originally made, is illustrated in Fig. 1. It consisted of two copper tubes, *Cu*, connected to the wire *W*, and a carbon tube, *C*, connected to the wire *W'* immersed in a solution of cuprous chloride. Two glass plates, *G G*, extend nearly to the bottom of the solution, acting as separators between the carbon tube and the copper tubes.

Coal gas was forced into the copper tubes and allowed to escape at the lower ends, bubbling out through the solution. Air was introduced through a glass tube into the interior of the carbon tube from below and allowed to escape through a small aperture at the

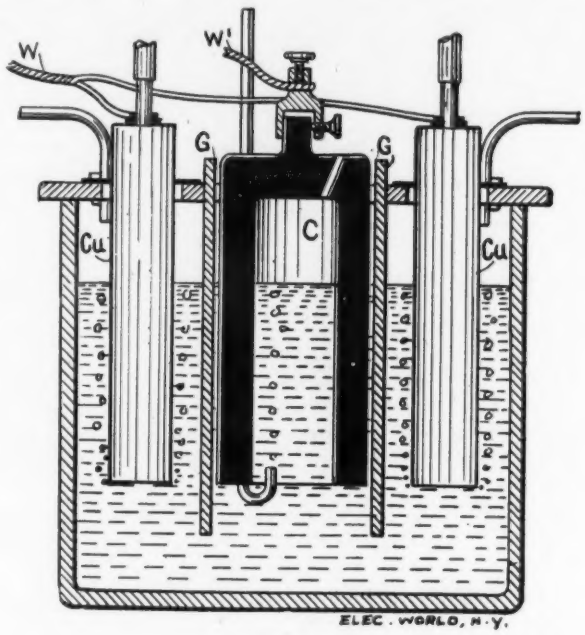


Fig. 1.

upper end. Dr. Borchers states that he first tried carbon for both poles, but of the results of this arrangement he gave no report, except to say "if they were not entirely discouraging, they at least did not even approach my expectations." He then used copper tubes for one electrode and carbon for the other, as shown in Fig. 1. From this arrangement he obtained a measurable potential difference, and he would have obtained the same result without using either the air or the gas, the apparatus being in itself a galvanic battery of the ordinary type in which a corrodible and an incorrodible conducting element are immersed in a corrosive or oxidizing electrolyte. His excuse for substituting copper in place of one of the carbon electrodes was that it is cheaper than platinum. He might have used zinc under the same pretext and obtained better results. His supposition that the copper would not be oxidized was incorrect, and Dr. Borchers has now abandoned the copper on that account.

Table I. shows the results obtained in this experiment, using coal gas in the copper tubes and air in the carbon tube.

TABLE I.

External Resistance. ohms.	Potential Difference. volts.	Current, amperes.
0.1	0.05	0.5
1.0	0.20	0.20
2.0	0.23	0.13
3.0	0.25	0.10
5.0	0.275	0.060
10.0	0.30	0.040
20.0	0.40	0.020
50.0	0.40	0.008

The solution employed as the electrolyte was an acid solution of cuprous chloride. Dr. Borchers states also that he tried an ammoniacal solution of cuprous chloride, but he stated no results of

that experiment except to say that the acid solution gave better results than the alkaline.

These results show clearly that chemical action takes place in the cell with liberation of electrical energy, but they show nothing further. They do not show whether it is due to the action of the gases introduced, or to the chemical action of the electrolyte on the copper electrode. If he had measured the potential difference and current of the cell before introducing the gases, he might have determined that question. This simple and obvious experiment Dr. Borchers in his remarkable research did not consider of sufficient importance to try—or at least to report.

The writer of this communication had, previous to the experiments of Dr. Borchers, tried the experiment with carbon tubes as electrodes, with and without carbon monoxide, and could obtain no deflection of a delicate galvanometer in either case.

It has long been known that cupric chloride, especially in presence of free hydrochloric acid, corrodes metallic copper with formation of cuprous chloride, the reaction being as follows:

$$Cu + CuCl_2 = Cu_2Cl_2. \qquad (1)$$

When Dr. Borchers published his first paper it was thought that the source of his E. M. F. was the chemical reaction between the copper tube and the cupric chloride, which would unavoidably be present in his solution. Attention was called to this fact in a communication to THE ELECTRICAL WORLD of December 22, 1894, from which the following statements are quoted:

"If the doctor will carefully analyze the materials he employs and the products he obtains, he will make another startling discovery. He will discover:

"First, That the increase in weight of his copper tubes is due to the formation of a coating of insoluble cuprous chloride, Cu_2Cl_2, produced by the corrosion of the copper tubes.

"Second, That the oxygen absorbed by the cuprous chloride solution does not combine at all with the carbon monoxide or other fuel gases, but is used solely in oxidizing the cuprous to cupric chloride, according to the following equation.

$$O + Cu_2Cl_2 + 2HCl = 2CuCl_2 + H_2O. \qquad (2)$$

The ultimate and only product of the reaction is cupric chloride produced at the expense of the copper tubes.

"Third, That the energy evolved as electric current is due to the corrosion of the copper tubes and to nothing else.

"Fourth, That the same results would have been obtained by his apparatus if he had not used any gases at all.

"If the reactions supposed by the doctor to have taken place did actually occur, they would occur in the same manner with both electrodes of carbon and there would be a continuous evolution of carbon dioxide."

The correctness of these statements has been repeatedly demonstrated experimentally since that time by a number of investigators, whose results have not been questioned. We will refer particularly to the results obtained by Mr. Fuge, published in the London *Electrical Review* of February 8, 1895, and in THE ELECTRICAL WORLD Digest of March 2, 1895; also to the results obtained by Mond, published in the London *Electrician* of January 11, and in THE ELECTRICAL WORLD of March 16, 1895. The results obtained by Mond are given in Table II.:

TABLE II.

Electrodes.	Solution.	E. M. F. in Volts.
Carbon and copper	Hydrochloric acid, 25 per cent.	0.606
" " "	Cupric chloride and hydrochloric acid	.4655
" " "	Cuprous chloride and hydrochloric acid	.3774
" " "	Carbon in cupric oxychloride and HCl / Copper in cuprous chloride and HCl	.4315
" " "	Carbon in cupric oxychloride and HCl / Copper in Cu_2Cl_2 CO and HCl	.4107
Carbon and carbon	Carbon in Cu_2Cl_2 + HCl + air / Carbon in Cu_2Cl_2 + HCl + CO	.0015
" " "	Carbon in Cu_2Cl_2 + HCl + air / Carbon in Cu_2Cl_2 + HCl + coal gas	.0050

The results obtained by Fuge are as follows:

TABLE III.

Electrodes.	Solution.	E. M. F. in Volts.
Carbon and carbon	Cuprous chloride and hydrogen and air	0.038
" " "	Cuprous chloride and coal-gas	0 038
Carbon and copper	Cuprous chloride and no gases	0.66
" " "	Cuprous chloride and CO, no air	0.54
" " "	Cuprous chloride and CO, with air	0.54

Mr. Fuge states that the copper plates lost in weight. His standard of E. M. F. was a Leclanché cell, assumed to be 1.6 volts and his results may, therefore, be a little too high. A comparison of the results obtained with and without the gases, both by Mond and Fuge, shows that E. M. F. was not due to the gases.

Notwithstanding these demonstrations Dr. Borchers continued to argue that the electrical energy might be derived from the oxidation of the carbon monoxide, basing his claim upon the following reactions:

(1.) $Cu_2Cl_2 + CO + H_2O = Cu_2 + 2HCl + CO_2$

(2.) $Cu_2Cl_2 + CO + 4NH_3 + 2H_2O = 2Cu + 2NH_4Cl_2(NH_4 + CO_2$.

The last equation undoubtedly represents a possible chemical reaction, and for the purpose of this discussion only, we shall admit the possibility of either of the reactions. As Dr. Borchers claims that his energy is derived from the oxidation of carbon monoxide in the above reaction to CO_2, and not from reactions between any of the other reagents presents, such as the conversion of ammonium hydrate into chloride or carbonate, we must not consider any energy changes, except those concerned in the conversion of CO into CO_2. It is evident, as admitted by Dr. Borchers, that the conversion of CO into CO_2 in both of the above reactions is accomplished, not by the direct action of the oxygen (no free oxygen appearing the equation), but by the reduction of cuprous chloride to metallic copper, as shown in the equations. Admitting, for the benefit of Dr. Borchers's theory, that all by-products, except the CO_2, may be regenerated without cost or expenditure of energy, we have, as the source of energy, that is, the original materials from which it is derived, only gaseous carbon monoxide and cuprous chloride. We have, as products of the reaction evolving the energy, to consider only metallic copper and gaseous carbon dioxide. Any energy that may be evolved or absorbed by these bodies while going into or out of solution or while undergoing previous or subsequent combinations must be excluded. The energy evolved by this oxidation cannot exceed the combustion heat of carbon monoxide diminished by the formation-heat of cuprous chloride.

The combustion heat of carbon monoxide has been determined by various investigators, the highest being that of Thomsen, 68.370. The formation heat of cuprous chloride has been determined by Berthelot to be 71,200. From these figures we see that the reaction of Dr. Borchers, instead of evolving energy, cannot take place without absorbing energy. If it is found to take place, therefore it must do so by the aid of some other reaction, such as the reaction between cuprous chloride and the hydrochloric acid solution; which reaction would absorb from 800 to 9000 calories, depending on the strength of the solution. It is evident from this that there is no possibility, even in theory, that the electrical energy in Dr. Borchers' original experiments was evolved by the oxidation of carbon monoxide, and this conclusion is amply proved by the experiments cited above.

What, then, was the probable source of the electrical energy (amounting to about 0.04 watt) in this battery? The experiments of Borchers and of those following him indicate that it was the action of the solution upon the copper electrode—a reaction that would necessarily take place under the circumstances. Some cupric chloride would necessarily be present while air was forced through the solution or while the solution was allowed to be in contact with air. The cupric chloride would immediately convert the copper into cuprous chloride, according to equation (2) above. The cuprous chloride is formed as a solid and anhydrous precipitate on the surface of the copper.

The formation heat of cupric chloride varies between 51,630 and 62,710, depending on the strength of the solution, while that of solid cuprous chloride is 71,200. The heat evolved by this reaction is therefore, a quantity varying between 71,200 — 51,630 — 71,200 — 62,710, or between 19,570 and 8490 calories, corresponding to an E. M. F., varying with the degree of concentration of the solution, between $\frac{19,570}{1 \times 23,260}$ and $\frac{8490}{1 \times 23,260}$, or between 0.84 and 0 36 vo t.

Between these limits are included all the observed values recorded by Borchers and those who repeated his experiments, meaning the E. M. F. on open circuit. We see, therefore, that there is in the Borchers battery a sufficient source of E. M. F. without the use of air or gases, to account for all the results, and that it is a battery of the ordinary type, in which metallic zinc is replaced by metallic copper. The experiments cited show also that the output of electrical energy is not increased, but is sometimes decreased by the introduction of the air and gases. If the carbon monoxide has any useful function in this battery it is not in producing electrical energy by its oxidation, but in regenerating some of the exhausted material by a subsequent reaction, viz., by reducing metallic copper from cupric chloride. This is precisely the function performed by solid carbon in reducing metallic zinc from zinc oxide in a retort or furnace.

Digest of Current Electrical Literature

American and Foreign.

by Carl Hering.

DYNAMOS, MOTORS AND TRANSFORMERS.

Method of Preventing Sparking. FISCHER-HINNEN. *Elek. Zeit.*, Dec. 30.—A short illustrated article in which, after claiming priority of invention of what is known as the Ryan method, he describes an improvement which he considers better. He claims that the action of the additional winding in the Ryan method is generally misunderstood, as it is supposed that the number of ampere windings in the compensation winding must be equal to that in the armature, in order to completely neutralize the armature reaction and prevent sparking; this view of the action is, however, correct only as far as it concerns the armature reaction, but the sparking is only very indirectly related to the armature reaction; for the sparkless position the brushes must be moved so far forwards that the counter E. M. F. induced at that point will complete the process of commutation within the time during which the short circuit lasts. The requirements are therefore not always the same as those for the complete suppression of the armature reaction. He then describes the well-known Swinbourne method of placing two small magnetic poles, with separate exciting coils, opposite the armature in the direction of the neutral zone; with some forms of dynamos, as for instance in the Manchester type, a much simpler arrangement becomes possible; the cores of these small poles exist as before, but the compensating coils are wound directly on the main magnets above and below the auxiliary pole pieces, one coil being wound in one direction, and the other in the reverse, that is, there will then be a different number of ampere turns between one of the auxiliary pole pieces and say the north pole of the machine than there will be between that auxiliary pole piece and the south pole; thus additional lines of force will be generated between the south auxiliary pole and the main north pole; the same will be the case between the north auxiliary pole and the south main pole; the total number of ampere windings will be the same as before; it suffices therefore to subdivide the original ampere turns on the magnets into two unequal parts, one of which is placed on one side and the other on the other side of the place where the auxiliary pole connects with the core. He thinks such methods of compensation do not receive the attention they deserve; the excellent action of the compensation method was shown recently in a small 400 ampere machine, which could not only stand three times the normal current, that is 1200 amperes, but at this load it was absolutely impqssible to tell from the brushes whether the current was flowing or not. If this method is used for motors it has the additional advantage that the speed can be regulated between wide limits by merely changing the field, that is, without appreciable loss of energy.

High-Speed Three-Phase Motors. KUEHNEL. *Elek. Zeit.*, Dec. 30.—A reprint of a recent paper giving an illustrated description of some very high speed motors which are connected directly to high speed wood working, polishing and grinding machinery, the speed in most of which is about 400 revolutions per minute; great difficulties arise in using the ordinary continuous current motors for such high speeds, but these are overcome by the use of three-phase motors with short circuited armatures, the construction of which is exceedingly simple; the efficiency of such motors is claimed to be appreciably higher than that of the usual slower speed motor with the required transmission.

Diphase Laboratory Installation. HANAPPE. *L'Eclairage Elec.*, Dec. 25.—A continuation of his long description of the apparatus of the school at Mons, which has already been referred to.

Windings of Polyphase Armatures. STONE. *Amer. Elec.*, Jan.—Illustrations and diagrams of the several different windings used on single, two or three-phase armatures. The manner of connecting the windings of polyphased armatures is largely a matter of convenience, and does not influence the workings of the machine; in rotary transformers the delta winding, however, is essential, and when a neutral is used in a three-phase system the star or Y connection is necessary.

Operation of T.-H. Arc Machines. GILES. *Amer. Elec.*, Jan — Practical information is given for the adjustment and care of T.-H. arc machines.

Repairing Burnt Out Commutators. CROWELL. *Amer. Elec.*, Jan.—Practical instructions are given for locating a defective wire in a commutator, and for making the necessary repairs.

LIGHTS AND LIGHTING.

Arc Lamps from Alternating-Current Stations.—Lond. *Elec. Eng.*, Dec. 24.—Answers to the questions what the various methods are for running arc lamps from an alternating current station, and which is considered the best. One correspondent enumerates the seven different methods, and discusses each separately, concluding that the best system is that in which the least variation in the types of machinery is required; with more efficiency alternating current lamps the separate circuit system from sub-stations would appears to be the best; the rectified current system, however, is much used at present. Fennell also enumerates the six systems, stating that it is extremely difficult to state which is the best, as circumstances differ; a really good alternating lamp is difficult to obtain, and he is therefore inclined toward the continuous arc lamp, preferring a series system if there are many lamps, and of these the motor dynamo system is the better, although not much more so than the one in which the rectified current is used. Another correspondent gives diagrams of eight different systems, and discusses them.

Leading-in-Wires for Incandescent Lamps. COWPER-COLES. Lond. *Elec. Rev.*, Dec. 31.—A short article in which he gives a table of the coefficients of expansion for various metals and glass, and discusses briefly the various methods which have been suggested in which the expensive platinum is replaced by cheaper material. The value of the platinum in each filament varies from about one to two cents, and assuming that about 50,000,000 lamps are in use, the value of the platinum in them is about $1,000,000. It appears that none of these methods have proved to be a success. He states that antimony may be used to lower the coefficient of expansion of iron and nickel; the iron or nickel must be in considerable excess to give the necessary strength, and therefore 1 to 5 per cent. of antimony is suitable; the wire made from such an alloy is covered with platinum by placing it in a platinum tube and drawing it down in the usual way.

Renewable Incandescent Lamps. HOWARD system. Lond. *Elec. Eng.*, Dec. 31.—An illustrated description of the last method referred to in the article noticed in the *Digest*, Jan. 15.

Train Lighting.—Lond. *Elec.*, Dec. 31.—A note stating that the Northern Railway Company of France has decided to light all its cars electrically; secondary batteries will be used, carried on trays beneath the car body; the time of charge and of discharge is five hours.

New York City.—Elec. Rev., Jan. 12.—A note stating that nearly $14,000 worth of electricity is used every night in New York City for illuminating purposes; there are 1,030,468 arc and incandescent lights, with an estimated candle power of 50,000,000.

Enclosed Arc Lamp. FREEDMAN. *Amer. Elec.*, Jan.—An illustrated description of the principles and mechanism of the enclosed arc lamp. The considerations affecting the lack of carbons are enumerated, and curves given showing the distribution of light.

POWER.

Regulator for Electrically Driven Looms. CHAIZE. *L'Eclairage Elec.*, Dec. 25.—A brief abstract of a recent paper in which he describes a regulator of extreme sensitiveness, to be used with such machines. It consists of a small centrifugal governor driven by the motor, and operating a lever which breaks the circuit under water; ordinarily the metallic parts are connected, but when the speed increases the main current which passes through this contact is broken under the water, depriving the motor of current until the speed has fallen to the normal value. It is in use on a large number of looms in France, and gives better results than rheostats.

Water Power Plant on the Sihl.—Lond. *Elec.*, Dec. 31.—An abstract of an illustrated article from a Swiss journal by Wyssling, describing this plant, in which a very inconstant flow of water furnishes light and power to twelve villages. About 1200 to 2000 horse-power are generated, the hydraulic head being from 200 to 245 feet; the dynamos are two-phase machines, so dimensioned that from either one of the phase windings of the armature the full 400 horse-power can be taken as a single-phase output, assuming an absence of a difference of phase between the current and the voltage; as a two phase machine it can deliver its full power of 400 horse-power to a motor load with even a very large phase difference, as it could furnish double the current required if there were no lag.

Laval Steam Turbine.—Lond. *Elec.*, Dec. 31.—An abstract from Lond. *Engineering*, giving some additional particulars, including a table of the steam consumption and referring to the recent tests at the Stockholm exhibition.

Marine Boilers for Central Stations.—Lond. *Elec. Eng.*, Dec. 24.—Answers to the question what the opinions are to the use of marine type of boilers for central stations; three answers are published.

Dust Destructors.—Lond. *Elec. Rev.*, Dec. 31.—A continuation of the discussion which has been going on for some time; there is a communication by RAWORTH and by BROOKMAN.

Alternating-Current Patents.—Amer. Elec., Jan.—Several patents recently issued to R. M. Hunter, and claimed to fundamentally cover alternating current working are criticized; dates are given showing that the principles of stepping up and stepping down volt-

ages were described in a text book half a century ago, and patents on the same were obtained by Berliner in 1877, Rosetti in 1880, and Deprez in 1881. In 1882 Gaulard & Gibbs gave a demonstration in London of the series transformer system, and the Zipernowski-Deri patents on the arrangement of transformers in parallel date from about 1885. It is concluded that if there is anything at all patentable in the alternating current system of distribution it would appear to be on the placing of transformers in parallel, which claim might possibly, however, receive no greater weight in court than did the Edison claim for the ordinary parallel incandescent lamp system of distribution.

Niagara Falls.—Elec. Rev., Jan. 12.—A short article on the local use and the transmission to Buffalo. At the close of the year 15,000 horse-power was available, but in the course of a few months 25,000 horse-power additional will be available.

Niagara Power in Buffalo. FOSTER. *West. Elec.*, Jan. 8 —A short paper recently read in Buffalo, in which he shows what has been done up to the present time to place the power in condition for use in that city.

Power Development at Massena. DUNLAP. *West. Elec.*, Jan. 8.—A short illustrated description of this power plant, to which frequent references have already been given.

Rand.—El'ty, Jan. 12.—A reprint, without the illustrations, of the article noticed in the *Digest*, Dec. 11.

TRACTION.

Accumulator Car.—Elek. Zeit., Dec. 30.—A brief description of a car which is being tried experimentally in Berlin, on which the Ribbe accumulators are used; it is to be run regularly and to be charged once a day, one charge being sufficient for 170 km. The car has two axles and accommodates 33 passengers, the weight without accumulators being 6.6 tons, the accumulators weighing 3.4 tons; it has one motor of 30 horse-power, and the batteries are divided into two groups, which are connected in parallel for starting; there are 132 cells; the retaining cells are made of celluloid which contains very little nitrogen; the capacity of the accumulators is 300 ampere hours, and the charging current 40 amperes, the normal discharging current being 35.

Fly Wheels for Railway Generators.—Lond. *Elec. Eng.*, Dec. 31.—Answers to a request for reasons for and against the use of flywheels for railway generators.

Storage Battery Cars in Chicago.—Eng. News, Jan. 6.—A long, well illustrated description of the storage battery line which is in regular use in Chicago, and on which ten to twenty cars have been run on about 12 miles of track since June; the information was obtained from various sources; the illustrations show also the transfer carriage for handling the batteries, which as will be remembered, are raised from below and suspended from the bottom of the car.

Electric Railway in Alaska.—El'ty, Jan. 12.—An editorial note stating that a company is said to be formed in Seattle which proposes building a road over the Skaguay trail, in which a single rail system will be used, the track being 6 feet above the surface. Another company proposes to use an aerial form of railway, in which the transportation will be by rope.

Electric Railway Practice. PARHAM. *Amer. Elec.*, Jan.—Instructions are given for the installation of a trial equipment and on methods of testing the same.

Clontarf.—El'ty, Jan. 12.—A reprint, without the illustration, of one of the descriptions of this railway noticed in the *Digest*, Jan. 15.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Central-Station Statistics.—Lond. *Elec. Rev.*, Dec. 31.—A supplement in the form of a large folded table giving a list of the electrical works in the United Kingdom, divided into alternating and continuous current plants, and these again into those in London and in the provinces. The table contains considerable data in twenty-two columns, in which there are only few omissions.

Central Stations. FELDMANN. *Elek. Zeit.*, Dec. 30.—The conclusion of his recent lecture (see *Digest*, last week). He continues the discussion of the question of different kinds of loads, and concludes with a discussion of the methods of charging for the current; no general conclusions are drawn, except that he claims to have shown that in general the methods indicated by gas companies should be followed.

Rouen.—L'Eclairage Elec., Dec. 25.—An illustrated description of this station, where both continuous and alternating currents are generated.

Electric Supply in Paris.—Lond. *Elec.*, Dec. 31.—A brief abstract of the recent report by Bos, which was noticed in the *Digest*.

Private Plant.—Amer. Elec., Jan.—A long, well-illustrated description of the lighting and power plant of the American Lithographic Company, in which 141 motors are employed, ranging from 2 to 35 horse-power each. All the wiring is carried in armored conduit; there are two distinct wiring systems, so that if one wing of the building becomes disabled the remaining portion may be operated independently of the crippled part; the feeders for lighting and for power are entirely separate, and connect on the floors with a special panel board; the construction is such that the whole wiring system from the switchboard to the centres of distribution is made entirely fireproof, and at the same time all parts of it are readily accessible for repairs and additions. All motors are direct connected, either to presses, folding machines, etc., or to counter shafting. Careful records are kept of cost, and show a saving of 44.2 per cent. over the cost for power and lighting before the plant was installed; an electrical horse-power at the switchboard is produced on 4.05 pounds of coal, including all the units; considering only the large Corliss engine units in the daily ten hour runs, an electrical horse-power at the switchboard is produced with 3.25 pounds of coal per hour.

Cost of Electric Service.—Amer. Elec., Jan.—Figures are given showing the present cost of electric service for electric lighting and power in New York City. On the lamp-hour basis, and with 50 watt lamps, there is a minimum charge for incandescent service as low as eight cents per kilowatt hour, including renewals; for arc lighting the minimum is 4 cents per 2000-cp lamp hour, the consumer furnishing the lamp, but not the trimming and the carbons. The minimum rate for power service is four cents per horse-power hour; on the wholesale kw hour basis the minimum is as low as five cents per kilowatt hour, or three and three-quarters cents per horse-power hour, the consumer supplying renewals and trimming. The minimum charge for incandescent lighting service is $1.50 per month, and for arc lamps the mimimum is $3 per lamp per month.

Multiple Rate Metering. OXLEY. *West. Elec.*, Jan. 8; begun in *Elec. Rev.*, Jan. 12.—A rather long article describing a new way of applying a double rate method of charging, the method having been in use for some time, and with success. He claims that the double rate method, or discounts based on the time of demand, is the best adapted to the requirements; only a single meter is used, and by means of a controller a resistance is inserted in each meter circuit at the hour when the low rate is to begin, and this retards the speed of the motor corresponding to the lower rate of charge. An illustrated description of the apparatus is given; the change of the readings is accomplished by means of a double throw switch at the central station with the aid of an earth connection, the controlling switch at the meters having also an earth connection; there is no special control wire required.

Brooklyn. WETZLER. *Elec. Eng.*, Jan. 6.—A very long, illustrated description of the plants of the Edison Electrical Illuminating Company, of Brooklyn, describing its development, its present and future work; the article includes a large folded map of Brooklyn, showing the electric supply mains. Both the alternating and the direct current systems are used, as also a storage battery. An illustrated description of these plants was published in THE ELECTRICAL WORLD some time ago.

Light and Power Plant. HOFFMEISTER. *Amer. Elec.*, Jan.—An illustrated description of a lighting and power plant in a smelting works at Trail, B. C. There are two 36-inch Pelton wheels operating under a head of 260 feet, and generating about 400 horse-power. There are three direct current generators and two motors of 1125 horse-power each.

Japanese Electric Light Stations.—Power, Jan.—Brief, illustrated descriptions of several Japanese stations, the outfits of all of which are made in Japan, some of them consisting of alternating current generators of large size, directly connected with triple expansion engines.

Switchboard Ground Detector. SANBORN. *Amer. Elec.*, Jan.—A ground detector on the switchboard in connection with two lamps, one illuminating the rear and the other the front of the switchboard.

Automatic Rheostat. WEAVER. *Amer. Elec*, Jan.—A gravity form of rheostat is described, which is claimed to be superior to those depending for their action upon springs.

Operation of Municipal Franchises. BOWKER. *Elec. Eng.*, Jan. 6, and *Elec. Rev.*, Jan. 12.— The beginning of a reprint of the article noticed in the *Digest*, Jan. 8.

WIRES, WIRING AND CONDUITS.

Fuses versus Circuit Breakers. DOWNES. HARRINGTON. *Amer. Elec.*, Jan.—A continuation of the discussion of the relative merits of enclosed fuses and circuit breakers. Downes considers that it is now generally admitted by engineers that for properly designed fuses there is a wide field of usefulness in which circuit breakers are not applicable, and that this field is not small in extent; on the other hand, he admits that there is an equally wide field of usefulness for the circuit breaker, and one in which it will unquestionably continue to be used. He states that with a properly designed fuse connected in series with a circuit breaker, which is set at a point not greatly in excess of the normal load of the fuse, the circuit breaker will on short circuit apparently operate later than the fuse, since there is no sign or flash or spark at the carbon break. If circuit breakers will not permit of abnormal rushes of current, he asks why it is that it is not an unusual occurrence for those of excellent design to be totally destroyed by short circuit. He criticises the suggestion that enclosed fuses should be operated at their maximum continuous carrying capacity, owing to the difference that will exist in surrounding temperature; he considers that an air chamber is necessary in an enclosed fuse, as otherwise its maximum carrying capacity changes with the length of time the fuse is in circuit. Harrington believes that enclosed fuses would be better than open fuses if a uniform standard were adopted, and never departed from, but this he considers improbable; the variables entering are so many that no two manufacturers would produce a similar type of fuse, while the magnetic circuit breaker by simplicity of construction, self-contained adjustment and freedom from the effects of environment, is free from variable factors.

Municipal Electrical Inspection.—Amer. Elec., Jan.—The publication of electrical inspection codes of municipalities is criticised; municipal inspection should under no circumstances be encouraged so far as it relates to interior electrical work, as the great interests the underwriters have at stake assure much more efficient inspection than can be expected from the usual city employee; if, in addition, electrical contractors are to be harassed by having to comply with arbitrary code compilations by city electricians, the evil is greatly increased and may develop into an intolerable one through the intrigues of politicians.

Control of Lamps on Three-Wire Circuit. Lee. *Amer. Elec.* Jan.—A diagram of the connections of a three wire double end switch.

ELECTRO-PHYSICS AND MAGNETISM.

Counter E. M. F. of the Arc.—Lond. *Elec.*, Dec. 31.—A long editorial discussing the subject and referring briefly to the various recent researches in this direction, all of which were duly noticed in the *Digest*. It is thought that there is considerable weight of evidence in favor of the belief in the existence of such a counter E. M. F. It questions whether the result of a thermal or chemical polarization could be detected by any direct method after the suppression of the current. Sahulka discovered that when a circuit is formed from a carbon electrode immersed in the arc vapor and either of the main carbons of the alternating arc, a direct current will flow from either of the main carbons through the outside circuit to the arc vapor; this experiment was confirmed by the editor, who found a direct E. M. F. of about 9 volts on a 10-ampere alternating arc; from this it is believed that there must exist a very appreciable back E. M. F. Blondel's recent experiments to the contrary, however, have great weight against such a hypothesis; the inherent weakness of the test lies in the assumption of a lag in time of any back E. M. F. The action on the arc of the wave form is also discussed. It is concluded that there are certain reactions in the arc which it seems possible to explain only on the assumption of quite a substantial E. M. F. due to thermo-electric causes ; the question is therefore still unsettled; it is a very ineffective argument to say that there is no single pair of elements yielding a voltage comparable with that required to maintain an arc.

Lag of Spark Discharges. Warburg. *Elek. Zeit.*, Dec. 30; abstracted briefly from the *Berl. Sitz. Ber.*, Feb.—If the difference of potential between two electrodes is brought to the sparking value, or even to a higher one, an appreciable amount of time elapses before the discharge actually takes place; this he calls the lag (Verzoegerung); it is quite variable in value, being smaller in damp air than in dry. The question arises what takes place between the electrodes during that time; he believes to have shown that a discharge takes place during this period by making experiments with the action of a magnetic field on a spark discharge; if a tube of rarefied air is placed in a magnetic field the path will be deflected, which is easily seen in the dark, and the voltage will rise or fall according to the position of the tube in the magnetic field; if the current is opposed by the field, the lag will increase and vice versa, from which he concludes that during this period there is an electrical discharge, although the current may be exceedingly small. During the discharge he believes that the air is changed from a good insulator to a relatively good conductor, and during the period of lag there is a very small current of increasing strength, which is followed by the spark discharge.

Rheostene. Van Aubel. *Jour. de Physique;* noticed briefly in the Lond. *Elec.*, Dec. 31.—He made some experiments with Glover's rheostene, which is a nickel steel of unknown composition, and has a remarkably steady temperature coefficient, besides a very high resistivity, which is 77.07 at 0.44°. He finds the temperature coefficient to be 0.00119 between 0.4 and 14.5°, and 0.00114 between 57 and 74°; at 100° it is 0.00098. The density is 7.899; it may be used for determining temperatures by the variations of its conductivity.

Resistivity of Bismuth. Van Aubel. *Archives de Genève;* noticed briefly in the London *Elec.*, Dec. 31.—The results of some further researches with bismuth obtained by various processes of purification. No reliance can be placed on the purity of chemically pure bismuth until it is further purified by electrolysis; the worst impurity is lead; the molecular construction has a great effect on the electrical quality if impurities are present, but has no effect if it has been purified electrolytically.

Superficial Distribution of Electricity. Stakloff. *L'Eclairage Elec.*, Dec. 25.—An Academy paper of a mathematical nature. "The existence of the density of a superficial layer without action on an interior point" has not yet been demonstrated, except in special cases; he now gives a mathematical solution of this problem, and also of the problem of Neumann for convex surfaces having a finite curvature.

Mercury Arc Lamp. Arons. Lond. *Elec.*, Dec. 24; noticed briefly from the *Wied. Ann.*, No. 12.—He explains that he has erroneously considered the cathode as hotter than the anode, and that the reverse is really the case; the mercury anode distils over into the cathode and is therefore hotter; the cathode shows a stormy surface, and the discharge proceeds from a bright point, while the anode is quiet and glows steadily; the glass is covered with finely divided matter, which is an objection to both the mercury and the amalgam lamp.

Atmospheric Electricity.—L'Eclairage Elec., Dec. 25.—Long abstracts of several papers read at the last congress of the French Association for the Advancement of Sciences. In a paper by Brillouin he discusses the origin, variations and perturbations of atmospheric electricity. Another, by Le Cadet, treats of the cause and origin of the electrical field of the atmosphere; he discusses the question of the size of the electric masses in the atmosphere and their distribution

Electrical Phenomena in the Sahara. Courmelles. *L'Eclairage Elec.*, Dec. 25.—A brief abstract of a paper read at the French Association for the Advancement of Science. He attributes the electric manifestation noticed in that desert and the production of ozone to the friction of the particles of sand raised by the wind, and the medical effects of the station at Biskra to this phenomena.

Electrical Conductivity of Discontinuous Conducting Substances. Branly. *L'Ind. Elec.* and *L'Eclairage Elec.*, Dec. 25; translated in Lond. *Elec.*, Dec. 31.—An Academy paper which was abstracted in the *Digest*, Jan. 8.

Absorption of Electric Waves. Eichenwald. Lond. *Elec.*, Dec. 31; noticed briefly from the *Wied. Ann.*, No. 12.—He made an important test which is a verification of Maxwell's fundamental equation; the method is simlar to that of Zeeman.

Luminescence. Wesendonck. Lond. *Elec.*, Dec. 31; abstracted briefly from the *Wied. Ann.*, No. 12.—He endeavors to show that certain curious temperature phenomena connected with luminescence do not contradict the second law of thermo-dynamics, which states that heat cannot pass from a colder to a hotter body by itself; he points out that this is not a direct transfer of heat, but it is more like a process by which a body in vibration may raise the temperature of a connected body by friction, although that body may have a higher temperature; luminescence therefore cannot be regarded as of the same nature as heat, but that like sound it may give rise to heat.

Species of Cathode Rays. Wiedemann and Schmidt. *Wied. Ann.* No. 12; abstracted in the Lond. *Elec.*, Dec. 24, and reprinted in *El'ty* (N. Y.), Jan. 12.—They found that these rays emerged from a point of the cathode in two essentially different ways; the first consists of a solid cone, which produces a patch on the glass, while the second is a hollow cone, producing a green ring on the tube; they studied the second kind, and conclude that the cathode rays proceed from the separating surface between a solid and a gas in the direction in which the current producing the oscillations traverses that surface.

Deflection of Cathode Rays. Kaufmann and Aschkinass. Lond. *Elec.*, Dec. 24; abstracted briefly from the *Wied. Ann.*, No. 12.—They measured the deflection by the second cathode ray, and obtained results in strict accordance with the projection hypothesis.

Magnetic Deflection of Cathode Rays. Kaufmann. *Wied. Ann.*, No. 12; noticed briefly in the Lond. *Elec.*, Dec. 24.—His paper above referred to, in conjunction with J. J. Thomson's recent work, indicates a probable victory of the projection hypothesis. Kaufmann therefore made a redetermination of the ratio of the charge of the projected particle to its mass, which ratio becomes a matter of great interest; this ratio now becomes 1.77 x 10 to the seventh power.

Influence Phenomena Due to X-Rays. Courmelles. *L'Eclairage Elec.*, Dec. 25.—A short abstract of a paper read before the French Association for the Advancement of Science, in which he concludes that a certain lighting effect which he noticed is due to a direct influence phenomena of X-rays.

Effect of Canal Rays on the Electrical Properties of Discharge Tubes. Wiedemann and Schmidt. *Elek. Zeit.*, Dec. 30; abstracted briefly, with the illustration, from a German physical journal.—The canal rays of Goldstein can be separated from the cathode rays by the apparatus described. They show among other things that gases which has been traversed by canal rays shield an electrodeless tube from electric oscillations, that is, they absorb such oscillations.

The Nature of Salts Altered by Cathode Rays. Abegg. *Elek. Zeit.*, Dec. 30; abstracted briefly from the *Wied. Ann.*, 62, p. 425.—He claims to have shown that the action is not chemical, but that the physical modification of the salts produced by these rays is still as mysterious as the rays themselves.

Heat Developed by Hysteresis. Weihe. *L'Eclairage Elec.*, Dec. 25; abstracted briefly from the *Wied. Ann.*, 41, page 578.—He made calorimetric measurements and found that for iron the measured heat is about 80 per cent. of that calculated from the hysteresis curve, while for steel it is about 75 per cent.

Magnetic Shielding. Du Bois. Lond. *Elec.*, Dec. 31.—A continuation of his long mathematical article, the first part of which was noticed in the *Digest*, Jan. 1.

Action of Röntgen Rays on Plants. Atkinson. *Science*, Jan. 7.—A description of some extensive preliminary experiments to determine what lines of investigations might be profitably carried on in order to find what influence, if any, the Röntgen rays would exercise on plants as a possible stimulant. An illustration is given of an ordinary and a Röntgen ray photograph of part of a plant. He found that plant tissues absorb the Röntgen rays quite freely, and was surprised to find that there was not a more marked influence on growing plants, and especially that there are no visible external injuries even when they are exposed to close range a large part of the time during several days. No other general conclusions appear to be drawn.

Röntgen Rays. Rollins. *Elec. Rev.*, Jan. 12.—A continuation of his notes. He gives the reasons why Lenard's X-rays were

feeble. In discussing the question whether the cathode stream goes forward in a high vacuum, he states that with the degree of vacuum used in producing Röntgen rays the position of the anode in relation to the cathode may be of importance. In discussing the question whether Röntgen rays are strongest when the anode is the source, he states that if the target for the cathode discharge is in line between the cathode and the anode it need not be an anode and with powerful generators it is better not to have the target the anode, as a cold target not in circuit does not blacken the tube as quickly as when it has the function of the anode; he also shows that there are two sources of Röntgen rays in every tube.

Capacity.—Amer. Elec., Jan.—The principles of condensers are described, and a simple method is given for the calculation of the E. M. F. set up in a condenser by the passage of a given alternating current, and for the calculation of the amount of current that would flow though a given condenser for a given impressed E. M. F.

ELECTRO-CHEMISTRY AND BATTERIES.

Galvanic Deposits of Aluminum.—L'Eclairage Elec., Dec. 25.—Brief descriptions of several processes used with Mannesmann tubes, with which an adherent deposit is obtained. The first coating is obtained by immersion, and it is afterwards increased by electro-plating; a coating may also be obtained by fusion, the articles being covered with gold or silver, as used for the decoration of porcelain, and then heated. The process of Lanseigne and Leblanc is also briefly described; the articles are first pickled in a dilute solution of caustic soda or hydrochloric acid; they are then brushed energetically in pure water, after which they are plated in baths, the composition of which is given in the abstract. It appears that the baths must be kept at a constant temperature of about 60° to 70° C.

Improved Oxide of Copper Battery.—L'Eclairage Elec., Dec. 25.—Illustrated descriptions of improved forms of the Lalande battery, consisting of zinc, potash and oxide of copper. The oxide of copper is contained in a perforated cylindrical box, inclosed by a porous diaphragm which avoids the short circuits; the zinc is a hollow cylinder which is suspended from the top; the method of adding the potash is simplified. The large cell has a capacity of 600 ampere hours, and an internal resistance of 0.03 ohms, the output being about 5 or 6 amperes at 0.8 or 0.9 volt; the parts are so proportioned that when the battery is exhausted they are all used up.

Production of Alkali Percarbonates.—Lond. *Elec. Rev.*, Dec. 31.—A note stating that at Zurich a method is being used which consists in electrolyzing a saturated solution of a carbonate of an alkali metal or of ammonium, at a temperature below 0° C. A saturated solution of potash made at minus 10° C and cooled down to minus 16° C may be electrolyzed, when a bluish salt is obtained, which is a percarbonate mixed with the carbonate; the current strength is from 1 to 300 amperes per sq. dcm. of anode surface.

Preparation of Chromium.—Eng. and Mining Jour., Jan. 8.—A brief description of the Aschermann system. A gas tight electrical furnace of steel is used in connection with a movable electrode; the oxide of chromium and the sulphide of antimony in the proportion of 10 to 23 is placed in the crucible, and a relatively light current of 20 to 25 amperes is passed through the material after the furnace is closed gas tight; the reaction which takes place is attended with the development of much heat; rapid melting of the regulus removes every trace of antimony.

Preparation of Carbides. MOISSAN. *L'Ind. Elec.*, Dec. 25.—An abstract of an Academy note describing a new method of preparing carbides by the action of carbide of calcium on the oxides; this material has an energetic reducing action; in fusion it acts energetically on the oxides; when no carbide is formed, as with lead, tin or bismuth, the metal is set free, but if their carbides exist they will be formed as a double carbide of that metal and calcium.

Electrolysis of Salt Solutions. LORENZ. Lond. *Elec.*, Dec. 31.—An abstract of the article noticed in the *Digest*, Dec. 18.

Theory of Accumulators.—Lond. *Elec. Rev.*, Dec. 31.—Brief extracts of the articles in German by ELBS and by LOEB, which were noticed in the *Digest* some time ago

Jacques Cell Discussion. OSTWALD. REED. *Amer. Elec.*, Jan.—Ostwald considers that there is not the slightest difficulty in regarding the Jacques cell just like any other electro-chemical cell, it being the same in principle as, for example, the Daniell cell. Reed charges that Jacques misrepresented his cell and its action; a comparison is made showing that the cost of generating power from the cell would be more than thirty times greater than the cost of steam power with coal at $3 per ton. While accepting the reactions offered by Ostwald, Reed takes exception to conclusions drawn therefrom, asking what the renewal of the exhausted material by subsequent and independent reaction has to do with the electro-chemical reactions in the batteries considered; and what the continuous operation of the cell or the renewal of ferric oxide has to do with the cost of E. M. F. He describes an experiment with a Jacques cell constructed of pure silver instead of iron, in which he found that the reduction of sodium required a much greater absorption of energy than that of iron, and which reduction cannot be explained on any theory except that of absorption of heat and the agency of a powerful thermo-electric current.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Testing Storage Batteries. KENNEDY. Lond. *Elec. Rev.*, Dec. 24 and 31.—An article describing how accumulators should be tested and compared with others. It is written more particularly for those who require tests to be made to guide them. The article is thoroughly practical in character, and the tests are very simple. He lays particular stress on the way in which the test is to be reported. Instructions of the makers should be carefully followed. For determining the dimensions a number of cells should be measured and the average taken; if no figure for the rate of discharge is given, then the tests should be made at 1 ampere per pound of plates, and then above and below this rate. Quite a considerable allowance is made for the different terminal voltages for different rates; the statement of the rate in the report is of great importance; the tests described are sufficient to enable anyone to judge of the merits of a battery. Great care should be taken in making comparisons of batteries of different sizes; the alteration of one factor may make the whole results of the same cell totally different in two tests; comparisons therefore are not fair unless made on the same basis. In making a new battery careful tests should first be made of a few plates. He describes a set of apparatus with which cells from 2 to 7 amperes discharge can be tested within an error of 1 per cent.; he recommends the use of a Silvertown primary battery for charging, when no other convenient source is available. These batteries, which he does not describe, will generate current at about 1.52 cents per ampere hour or half of this per watt hour; this would be cheaper than to take the current from a 100 volt circuit, when only a few volts are required. He lays great importance on studying the discharge per pound of plates in which it appears that the lugs, connectors and separators are not to be included. A tabulated form of such tests is given. When improvement is claimed for both plates then two tests should be made, one for the positives and the other for the negatives, as it is almost impossible to have them equal.

Capacity Relations in Cables. ANDRIESSEN *Elek. Zeit.*, Dec. 30—An article in which he develops the mathematical relations of the various capacities in a cable. He begins with the determination of the resultant of condensers connected in parallel and in series; he shows that the resultant of a number of condensers connected in parallel is equal to the sum of their capacities, while if they are connected in series the resultant is equal to the reciprocal of the sum of the reciprocals of the separate capacities; the voltages of condensers connected in series are therefore inversely as the capacities. It is not so simple, however, to subdivide the capacities in multiple wire cables into their component parts; this he then discusses, basing his conclusions on researches with a double-wire telephone cable; with this, three measurements enable the capacities to be determined between each wire and the earth and between the two wires; the first is the measurement of the capacity of one of the wires toward the others and the lead armor, the second is the same measurement of the other wire, while the third is the measurement of the capacity of both wires together toward the others and the armor; each of these three results will be the sum of two capacities, and by mathematical calculations each individual capacity can then be calculated. The correctness of the method is shown by a further experimental evidence. Another group of measurements shows what effect a wire next to a double wire has on the total capacity. Among the many problems which can be solved by such divisions of capacities, he also shows the application to determining a break in a cable if there is another wire in the same cable which can be used for measurement.

Insulation of Testing Instruments. WRIGHT. Lond. *Elec. Eng.*, Dec. 31.—Illustrations of some forms of insulators to be placed under testing instruments. A very good form is made of a round slab of hard rubber, with a circular groove cut in the upper surface, which is filled with paraffine; for high insulation properties a more complicated form is described. He recommends covering the whole table with a sheet of gutta-percha or ebonite; some forms of oil insulators are also described. Whenever possible gutta-percha covered wires should be used in preference to those of rubber, as the surface insulation can then be reduced to a minimum; when rubber-covered wire is used the ends should be prepared in a way which he describes; he does not favor the use of rubber gloves for high tension work, as they give a false feeling of security, and may lead to carelessness.

Tests for Faults in Submarine Cables. MURPHY. Lond. *Elec.*, Dec. 31.—A communication directed toward the recent article by Schaefer. He claims that it would be misleading to make quantitative comparisons of the results of various methods, with tests for the localization of the same fault or break; each method has its own range of applicability, and the true guides are training, experience and a careful study of cable testing. Schaefer's method should be looked upon as a supplement to Kennelly's two-current test, rather than as a rival, as it depends entirely upon circumstances which of the two methods should be preferred; he believes, however, that Schaefer's will come into more frequent use, as it is essentially adapted to testing short ends.

Localization of Breaks in Submarine Cables.—Lond. *Elec. Rev.*, Dec. 31.—An editorial article giving a short description of Kennelly's alternative methods, and of the modified laws advanced by Schaefer, which latter were recently described. The results of tests made by both methods are given. It is claimed that Schaefer's correction is not reliable; it is also claimed that the statement that such tests may be made with a rapidity heretofore unapproached by Schaefer's method is incorrect. Attention is called to an article by Cann and another by Rymer-Jones, published some time ago in that journal, and describing very simple tests.

Standardizing Ballistic Galvanometers. WIEN. Lond. *Elec.*, Dec. 31; abstracted briefly from the *Wied. Ann.*, No. 12.—He describes a new method, using a coil of a known inductance; it is a

reversal of Maxwell's method for measuring inductances by means of a ballistic galvanometer and a Wheatstone bridge; this reversal is thought to be a distinct gain; the theory of the method results from Maxwell's equations. The greatest source of error is in the heating effects, and to avoid this the galvanometer circuit should be closed, the deflection being measured only on breaking the battery circuit.

Electric Balloon Observations. BOERNSTEIN. Lond. *Elec.*, Dec. 31; abstracted briefly from the *Wied. Ann.*, No. 12.—In measuring the equipotential surfaces above the earth by means of balloons and kites, which are the most satisfactory methods, the observations are subject to an error due to the charge of the balloon itself; in the present paper he points out an easy method for eliminating this error, which requires only an additional collector and electrometer.

Protecting Instruments Against Vibration. BROCA. *L'Eclairage Elec.*, Dec. 25.—An abstract of a paper read at the Congress of the French Association for the Advancement of Sciences. Having noticed that soft rubber placed under the instruments sometimes made the effect worse, he studied the phenomena with the aid of mercury baths, and found that when placed on the table the waves produced by vibrations of the earth were quite great with a great frequency, but when placed on rubber the amplitude of the waves was much less, but their period greater in proportion to the mass. He concluded that rubber supports should be avoided if the apparatus has light oscillating parts, which are delicately suspended, and resource should be had to heavy and dampened platforms suspended by wires; but when the apparatus to be protected is rigid, or when the oscillating parts are relatively heavy, such rubber cushions will give good results.

Measurement of High Resistance with a Constant Current. MALMSTROEM. Lond. *Elec. Rev.*, Dec. 31.—An abstract of the article noticed in the *Digest*, Nov. 6.

Copper Voltameter. FOERSTER. Lond. *Elec. Rev.*, Dec. 24.—Abstracts of his two papers which were noticed in the *Digest*, June 19.

Switchboard Instruments.—Lond. *Elec. Eng.*, Dec. 31.—Some answers to the question as to what general type of ammeter or voltmeter is considered the most suitable for giving accurate readings for central station switchboards.

Cadmium Standard Cell. WACHSMUTH and JAEGER. Lond. *Elec. Rev.*, Dec. 31; abstracted briefly from the *Ann. der Physik u. Chemie*, p. 575.—They give some data concerning the H form of cell, which they recommend. An article by the latter author was abstracted in the *Digest*, Nov. 13 and 20.

Construction of a Thomson Astatic Galvanometer. WEBB. *Amer. Elec.*, Jan.—Instructions with working drawings for the construction of a suspended coil galvanometer; quite a number of the type described have been constructed and used at the Lehigh University for several years with good results.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telegraph Statistics.—Elek. Zeit., Dec. 30.—An abstract, with a large table, of the statistics for 1896, from the *Journal Telegraphique* for Nov.; it includes most of the European and Asiatic countries, and also the Western Union statistics for the United States.

Telephone Transformer.—Lond. *Elec. Eng.*, Dec. 31.—The illustration, accompanied by a brief description, of the one mentioned in the *Digest*, Jan. 15; the description is reprinted in *El'ty* (N. Y.), Jan. 12.

Telephone Cables.—Lond. *Elec Rev.*, Dec. 31.—An illustrated description of the leading types of telephone cables made by Siemens & Halske. The telephone cable of to-day is said to be an air space cable on which loosely wrapped paper is used.

Telegraph. LODGE. Lond. *Elec. Eng.*, Dec. 31.—Abstracts of his recent Royal Institution lectures on the principle of the electric telegraph.

Theory of Telephone Transmission. WIETLISBACH. *Elec. Eng'ing*, Jan. 1.—An attempt to show how to calculate theoretically the strength of current passing in a small telephone circuit, assuming that the operation of the microphone contact and the electrical qualities of the lines are known. He gives the principles for the vowels, which are also good for the consonants.

Telephone Switches.—Amer. Elec., Jan.—A pair of switches are described and illustrated, by means of which independent communication may be held between two telephones, both of them connected with the central by the same wire and occupying but one drop on the switchboard.

Independent Toll Line System. MARK. *Elec. Eng'ing*. Jan. 1.—The beginning of an article calling attention to the difficulties met with in designing an independent toll line system.

American Telephone Practice. MILLER. *Amer Elec*, Jan.—The multiple switchboard forms the subject of the present installment of this series.

Telephone Connections for Burglar Alarm Circuits. RUTHER. *Amer. Elec.*, Jan.—He shows how telephones may be installed upon a burglar alarm circuit, so that the operation of neither will be interfered with.

Ocean Cables in War Times. MORSE. *West. Elec.*, Jan. 8.—A short article from the Albany *Law Journal* describing the embarrassing disadvantage of the United States in war time owing to the fact that the cables might be cut or subjected to exclusive censorship by other countries.

Clock. HOPKINS. *Amer. Elec.*, Jan.—Instructions, with working drawings, for the construction of a clock operated by electromagnetic means from an ordinary clock at a distance.

MISCELLANEOUS.

Electricity Direct from Heat.—Amer. Elec., Jan.—In a criticism of a recent communication by Deprez concerning a new method of generating electricity direct from heat, it is stated that such an apparatus could only have an efficiency of 13 per cent. if the heat supplied were used at perfect efficiency. The working efficiency of such an arrangement would necessarily be small, owing to losses of heat; and its rate of doing work would also be small, thus necessitating an extremely large apparatus in comparison with steam engines of the same power.

Submarine Wrecking Boat.—Sc. Am., Jan. 8.—A well-illustrated description of the submarine boat devised by Lake, which contains a gasoline engine and a dynamo on the propeller shaft, the former being used when the boat is traveling at the surface and the latter, as a motor when the boat is submerged, storage batteries being used as a source of power; the charge of air is sufficient for a period of forty-eight hours.

Firing Blasting Fuses. FRANCIS. *Amer. Elec.*, Jan.—The results of practical experience with electric blasting fuses are given, and some peculiarities of their action pointed out.

Magneto for Firing Blasting Fuses. STERLING. *Amer. Elec.*, Jan.—The principles of the fuse firing magneto and its construction are described.

Electrical Spectacular Effects. PERSONS. *Amer. Elec.*, Jan.—Detailed descriptions are given of electrical arrangements used for producing spectacular effects at a church fair.

American Electrical Journals.—Am. Elec., Jan.—A list of the names of nineteen American electrical journals now regularly published, together with the date of the first issue of each under its present name.

Electrostatic Ground Detector.

The General Electric Company announces a new ground detector to take the place of the transformer and lamp method, which, although hitherto extensively used, has never given more than a rough indication of the condition of the lines. In the transformer and lamp method of ground detection, the extent of the ground is indicated by a lamp in the secondary circuit of the transformer, but on account of the capacity of the lines, the lamp nearly always glows, and the actual condition of the line is difficult to ascertain.

The new device is a switchboard instrument, and is similar in construction to that of electrostatic voltmeters used in laboratory work. Briefly, it consists

ELECTROSTATIC GROUND DETECTOR.

of four rigidly fixed sheet metal quadrants, between which is space for the accommodation of a vane carrying an indicating needle. The two lower quadrants are connected internally to the lower binding post for connection to the ground; the two upper to the right and left-binding posts respectively for connection to the lines. The vane with its needle is pivoted at the centre of the circle formed by the four quadrants, and is slightly counterweighted to balance the weight of the needle.

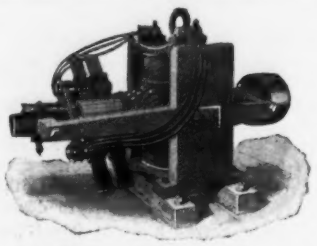
In common with all electrostatic instruments the operation of this ground detector depends on the tendency of the vane to place itself in the position giving the greatest condenser capacity. If no ground exists on the line the vane lies across the shortest path between the positive and negative quadrants, the right and left upper quadrants, and the needle points to zero. If, however, either side of the system be grounded, the two lower quadrants cease to be neutral, the system is out of balance and the vane, taking a new position, deflects the needle to the right or left, indicating the grounded side. A special feature of the construction is that the moving mechanism is insulated and has no electrical connection with either side or with the ground. If it were connected to either side of the line or to the ground, a burn-out might pos-

sibly result, but being insulated the moving mechanism can come into contact with one of the quadrants without causing any damage.

This electrostatic ground detector is constructed for 1000, 2000, 5000 and 10,000 volts, and is set in a black japanned case with cover finished in polished nickel.

Motor or Dynamo

The accompanying illustration represents the motor and dynamo manufactured by Mr. Maxwell M. Mayer, Second Avenue and 121st Street, New York City. Although his plating dynamo has been on the market for over three years, and is considered an efficient machine in this line of work, Mr. Mayer has recently gone into the manufacture of dynamos for electric lighting and motors of all sizes. A few of these machines, however, have been in operation for several years. They are, therefore, not entirely new, and have been subjected to the test of time. These machines are built on the same general lines as the plating dynamo, having a two-pole ironclad steel frame cast in one piece, with removable field coils. The armature is of the slotted-drum type, finely laminated to avoid heating. The commutators, which are of ample proportions, are made of tempered copper, insulated with sheet mica. Carbon brushes are used in a self-feeding brush holder. The mechanical construction of the machine is of the very best, the shafts being large and running in self-oiling bearings. The machines are efficient, smooth running and practically noiseless, and are made to last. They are built in four sizes, ranging from one-half to 4 kilowatts.



MOTOR OR DYNAMO.

Second-Hand Electrical Apparatus.

Few of our readers realize the scale on which second-hand electrical machinery and apparatus is dealt in in this country. This business is made possible only by the peculiar conditions attending the remarkable growth of electrical industries in the United States. Experience has demonstrated that the average electric light plant outgrows its capacity so rapidly that continual changes in the equipment are necessary. Smaller machines are, as a result, frequently being replaced by larger ones, and in this way innumerable dynamos, motors, etc., of all sizes and makes, are thrown upon the second-hand market.

The Charles E. Gregory Company, of Chicago, which is considered the pioneer electrical bargain house of the West, makes a specialty of handling such apparatus. Machines thus obtained are overhauled and thoroughly tested, and then again put on the market in a condition quite as good as new. This company does a large business in buying dynamos, motors, etc., of all sizes and makes, the work of overhauling and putting them in prime condition being conducted under the watchful care of experienced workmen.

The accompanying illustrations give a very good idea of the proportions of the Charles E. Gregory Company's business. The view of the dynamo and motor department shows machines of various sizes and makes, and the large stock of these is indicative of the magnitude of the company's trade

Not only does the company handle dynamos and motors, but hundreds of arc lamps, transformers, meters, and, in fact, everything pertaining to the operation of electric light and power plants, is kept in stock in large quantities.

WINDING DEPARTMENT.

In a business of the magnitude and character of that of the Gregory Company the repair department constitutes a very important adjunct. This department is very completely equipped for the work, and in every branch skilled workmen are employed in order that first-class and reliable results shall be produced. In the shipping department a variety of machines are all ready to be dispatched, after having been thoroughly overhauled and put in first-class order. Other large and important departments of the business are the commutator and machine room, the winding department and the supply department. In the latter the stocks of smaller apparatus are kept, such as transformers, switches, globes, lamps, etc. The view of the winding department shows a scene of activity, and depicts the actual work of armature winding. A large number of arc lamps depend from the ceiling, awaiting the proper treatment to put them in condition to throw light in dark places.

DYNAMO AND MOTOR DEPARTMENT.

News of the Week

Financial Intelligence.

THE EDISON ELECTRIC ILLUMINATING COMPANY OF BOSTON has declared a regular quarterly dividend of 1¾ per cent., payable February 1.

THE BOSTON ELECTRIC LIGHTING COMPANY has petitioned the State Electric Light & Gas Commission to allow it to increase its stock to the amount of $800,000. It is stated that the petition will be granted.

THE COLUMBUS STREET RAILROAD COMPANY reports gross earnings for December of $56,276, an increase of $3753, as compared with the same month of the previous year, and net $31,242, an increase of $4698. For the year ending December 31 the gross earnings were $609,681, a decrease of $20,220, as compared with the corresponding period of the previous year, and net $322,805, an increase of $1349.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Jan. 17, 1898

THE THIRD AVENUE RAILROAD COMPANY has completed negotiations whereby it will in a few days come into control of the system of the Union Railway Company, which is located in Bronx Borough. The Third Avenue Company, it is stated, has the option on more than a controlling interest of the $2,000,000 capital stock of the Union Railway. The latter system will add about 37 miles of owned and leased track to the Third Avenue Company's system, and carries with it the right to build 54 miles more. The two systems will be joined at 129th Street and Third Avenue, just below the new Third Avenue bridge over the Harlem River. By this deal the Third Avenue Company will secure a through line on the east to New Rochelle.

AN INTERESTING EXHIBIT was made in a Brooklyn court last Tuesday in connection with a suit for $30,000 damages, brought against the Nassau Electric Railroad Company by Mrs. Olga Paulson. The plaintiff claims that her right hip was fractured in jumping from an open car, the leap being the result of fright over the blowing of a fuse of one of the motors, and the flashing up of a flame. The railroad company ran wires into the Supreme Court room in Brooklyn, and connected them there with a motor box. A fuse box and the other appliances used on a trolley car were also supplied for the purpose of demonstrating that no flame such as the plaintiff described could have flashed up. A practical illustration was given for the benefit of the jury.

MR. S. DANA GREENE read an extremely interesting paper, and a valuable one, from a commercial standpoint, before the New York Electrical Society, on the evening of January 12. The title of the paper was "The Relations Between the Customer, the Consulting Engineer and the Electric Manufacturer." It is reproduced, practically entire, elsewhere in this issue. An interesting discussion followed the reading of the paper, in which Messrs. Osterberg, Mailloux, Dunn, Coho and Drs. Emery and Crocker, took part. The following resolution was adopted: *Resolved*, that in view of the excellent suggestions and recommendations on standardizing apparatus embodied in Mr. Greene's paper, the society hereby expresses its approval of efforts in that direction, and invites the American Institute of Electrical Engineers to consider some comprehensive plan for such standardization of American apparatus for light and power.

A FAREWELL DINNER was given on the evening of January 5 at Mouquin's restaurant, on Fulton Street, this city, to Messrs. Warren L. Murray and Gardner W. Kimball, of Westinghouse, Church, Kerr & Co. Mr. Murray, who is the auditor of the company, and Mr. Kimball, his associate, will hereafter be located in Pittsburg, to which city the auditing department of the firm has been removed. Mr. Murray has been connected with the company for fifteen years, and Mr. Kimball nearly as long, and during this long service they have won the respect and love of their associates. It was to testify to the esteem in which they are held that this dinner was given prior to their departure for their new homes. Plates were set for twenty-two persons. Mr. W. C. Kerr occupied the principal seat at the table, and Mr. O. L. Williams, the treasurer, acted in the capacity of toastmaster. The menu was an elaborate one, and the mental feast which followed was highly enjoyable.

THE METROPOLITAN STREET RAILWAY COMPANY has decided not to bid on the construction and operation of the proposed underground rapid transit railroad. This decision on the part of the company was formally announced to the Rapid Transit Commissioners by President H. H. Vreeland on January 12. Mr. Vreeland states that, owing to the announced intention of the elevated railroad company to enter into an agreement for the extension and improvement of its road, and that this movement has been received with approval by the present local authorities, the Metropolitan Company has no disposition to obstruct or to discredit the sincerity or the success of this undertaking. The directors of the Metropolitan Company do not, therefore, feel that, so long as the alternative method of securing the desired results appears about to be undertaken, they would be justified in asking the stockholders to engage in the construction of the underground road.

HARMONIZING STREET RAILWAY INTERESTS.—The Metropolitan Street Railway Company and the Forty-second Street, Manhattanville & St. Nicholas Avenue Railway Company have agreed to unite in applications to the Municipal Assembly for twenty-five-year leases to construct a double-track road, to be operated on the underground conduit system, substantially the same as that now in use in Fourth and Madison Avenues, on the Boulevard from 125th Street to 175th Street; on 145th Street, from the Boulevard to the Harlem River; on the Kingsbridge Road, from 162d Street to 230th Street, and on West 230th street and Riverdale Avenue to the city line. The road on the Boulevard from 125th Street to 169th Street will be operated by both companies, each company owning its own conduit and slot, but both using the same track rails. The road on the Boulevard above 169th Street, and that on 145th Street, will be owned and operated exclusively by the Metropolitan Street Railway Company, and that on the Kingsbridge Road and 230th Street and Riverdale Avenue will be owned and operated exclusively by the Forty-second Street Company. A paper setting forth these facts has been presented to the property owners along the various routes, and their consents will be asked for. The circular is signed by President H. H. Vreeland, of the Metropolitan Street Railway Company, and President A. J. Elias, of the Forty-second Street, Manhattanville & St. Nicholas Avenue Railway Company, and the Third Avenue Railroad Company. These two companies promise to develop the territory north of the Harlem River, and to charge a 5-cent fare from the City Hall to Yonkers.

AT THE MEETING of the New York Electrical Society which was held last Wednesday evening at the City College, President Pupin gave notice of an agreement between the society and the Electrical Exhibition Company, which is to hold an electrical exposition at Madison Square Garden next May. The occasion of this exhibition appeared to the society to afford the needed opportunity for putting itself prominently before the public as the oldest electrical body in the country and the recognized local society, and it has been very generously aided by the managers of the electrical exhibition in an effort to enlarge its scope of usefulness. The Exhibition Company has not only apportioned a space in the exhibition hall for a booth and rendezvous for the members and friends of the society, but has also placed at its disposal a contribution of funds for its educational work. This amount will be increased by a percentage of the admission receipts of the exposition, which is to be held "under the auspices of the New York Electrical Society." Members of the society will be admitted to the exhibition at half price. The electrical society is now organizing committees and laying plans for a hearty and active cooperation in the work of the exhibition, at the same time looking to an increase in its own membership and to fuller recognition as an authoritative influential body. The officers of the society urge the members individually and collectively to assist in making the exposition as brilliant a success as possible. It has been suggested that the Advisory Committee of the society, representing its interests with the officers of the exhibition, and for other exhibition purposes, should consist of the present officers and all the living ex-presidents, namely: Frank W. Jones, John M. Pendleton, Dr. F. B. Crocker, Joseph Wetzler, C. O. Mailloux, J. W. Lieb, Jr., and Dr. C. E. Emery. All of these gentlemen, it is understood, will gladly co-operate in the movement thus initiated. A resolution expressing the hearty approval of the members, and pledging themselves to active work, was adopted at the meeting.

PHILADELPHIA NOTES.

Branch Office of THE ELECTRICAL WORLD,
929 Chestnut Street,
PHILADELPHIA, Pa., Jan. 15, 1898.

THE McNAUGHTON LUMBER COMPANY, dealer in ties, yellow pine, etc., 303 Bourse Building, this city, states that there is considerable more inquiry for new material for the construction of electric railways. Although prices do not improve, there is more disposition to contract for future delivery at old prices. The outlook in the company's particular line is decidedly brighter.

THE PALMER ELECTRICAL INSTRUMENT COMPANY, whose office it at 26 North Seventh Street, in this city, has just issued its catalogue No. 3 of electrical instruments and laboratory apparatus. The illustrations are new and some novel designs of apparatus are presented. The instruments referred to are designed especially for experimental work in elementary and advanced electricity. Specifications of each instrument are given with the illustrations.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., Jan. 15, 1898.

THE MANAGEMENT of the Great Northern elevator is contemplating the installation of a line of shafting to prevent the overloading of the motors occasioned by the miscalculation of the builder. By this means the motors can be used to assist each other.

IT IS ANNOUNCED that the Cataract Power & Conduit Company will, in a few days, publish a schedule of prices to be asked for power in Buffalo. The latest announced application for power is that by the owners of the Sturges elevator, who want 500 horse-power.

THE PENSTOCK for the development of the 12,000 additional horse-power in the power house of the Schoellkopf Hydraulic Canal Company's system at Niagara Falls is going in. This company is already using the great part of the 8000 horse-power that was developed some time ago, and will have the additional amount on the market early in the spring.

LOCKPORT IS AGAIN studying the question of electric power from the Niagara River, obtained by means of a canal to be opened from the river a short distance below Tonawanda and carried over a gulf near the city, where it is said that the water can be used five times. Major Burbank, who planned the Niagara tunnel, is quoted as saying that 100,000 horse-power can be developed in that way at a cost of $10 per horse-power per year. The attorneys of a company already formed offer to dig a canal, to cost $6,000,000, and ask the city for only $50,000 a year for ten years for water to be taken from the canal for city purposes. The Lockport City Council is considering the matter.

THE FIRST ANNOUNCEMENT for a long time of the continued life of the Cataract General Electric Company, which was organized at $10 a share some years ago to receive the franchise enabling it to operate a trolley towing system on the canal, was made this week by the sale of some of the stock at $910 a share. This indicates life in abundance. When the Lamb towing system was tested on the canal bank at Tonawanda several years ago it proved an indifferent success, on account of the fact that the motor and a man to manage it had to be carried on the wire, which was not strong enough to support them. The company was to charge not more than $20 a horse-power annually to the boats, and light the locks free.

THE BUFFALO GENERAL ELECTRIC COMPANY has secured a concession from the Niagara Power people in the negotiations for power with which to operate the city lighting system next season. It has been generally understood that the company would give up its city steam plant as soon as the Niagara current was available, but the Cataract Power & Conduit Company has tried to establish a general rule, which provides for delivering to all customers the current at 2200 volts, three-phase alternating. The Buffalo General Electric Company asked for three-phase, 25-cycle current, but at 352 volts, which is most convenient, as from it 500-volt direct current can be obtained without the use of stationary transformers. The Buffalo Company would thus be enabled to sell power to small consumers with least cost for transforming. Officials of the General Electric Company from Schenectady and the Westinghouse Company from Pittsburg have been here several days, and it is agreed that the local company shall have what it wants. President Huntley, of the Conduit Company, has been to New York this week to see to the arrangement of details and order apparatus.

PITTSBURG NOTES.

PITTSBURG, Pa., Jan. 15, 1898.

GREENSBURG TROLLEY ROAD TO BE EXTENDED.—The annual meeting of the stockholders of the Greensburg, Jeannette & Pittsburg Electric Railway Company was held at Greensburg on January 10. The road will be extended to Irwin early in the spring, but no action was taken toward building the line between Greensburg and Mount Pleasant, for which this company holds the franchise.

POPULAR LECTURE ON ELECTRICAL SUBJECTS.—The managers of the Star course of entertainments have arranged for a lecture on the "Wonders of Modern Science," to be given at the Carnegie Music Hall on January 17, by Mr. W. J. Clarke, of New York. The lecture will be devoted mainly to electrical matters, such as wireless telegraphy, Moore's system of vacuum tube lighting, electric welding under water, the projecting kinetoscope, etc. The explanations will be illustrated by views and experiments.

NEW SOURCE OF WATER SUPPLY FOR THE LIGHT COMPANY.—In order to make itself independent of the city water works, and at the same time obtain economically an ample supply of water for boiler feed and condensing purposes, the Allegheny County Light Company is constructing, at an expense of $20,000, a tunnel between its station and the Allegheny River. The tunnel will be 600 feet long and 48 inches in diameter, and lined throughout with three courses of hard-burned brick. It is being laid 7 feet below low-water mark, and at the station end will terminate in a steel-lined well, 44 feet deep and 12 feet in diameter. Work was started on this tunnel last August, and unless some unforeseen obstacle arises it will be completed in about three months. It will give a practically unlimited supply of water with little expense, save the interest on the investment and the cost of pumping from the well. The tunnel passes under the properties of McIntosh, Hemphill & Co. and the Star Tin Plate Mill, and in return for right of way these companies have secured the privilege of obtaining water from the tunnel.

CHICAGO NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., Jan. 15, 1898.

A BILL was passed in the Illinois House of Representatives a few days ago taxing gas and electric companies 4 per cent. on gross receipts of over $50,000.

PRESIDENT TEALL, of the Underwriters' Association, has approved the proposition to make a department out of the Bureau of Electricity, on the ground that it would assure better protection against fire from faulty electrical construction.

THE GENERAL ELECTRIC COMPANY will be represented at the Northwest Electrical Association Convention, which will be held at Milwaukee, on January, by the following gentlemen from its Chicago office: Messrs. J. Scribner, R. A. Swain, P. A. Clisdell, F. H. Boyer, Thomas Ferris, of Milwaukee. The General Electric Company will make an exhibit which will consist of a full selection of wiring supplies, recording wattmeters, inclined coil instruments, new transformers, and long-burning arc lamps for direct current, alternating-current railway and power circuits. Its headquarters will be in a special room at the Pfister Hotel.

THE FIRM OF NELSON, MORRIS & CO., of this city, has just completed the installation of telephone and telegraph lines between Chicago and East St. Louis, for private use. The length of the line is 200 miles. The conductors are laid in a cable, one set being used for the telegraph, and the other for the telephone. The circuits are metallic, and it is stated that the telephone instruments work better between the two cities than the local instruments do for short distances. The firm built this line because the tolls over the regular long-distance system were found to be too heavy. The private line, it is reported, will save the company may thousands of dollars a year in telephone and telegraph tolls.

MILWAUKEE NOTE.

MILWAUKEE, Wis., Jan. 15, 1898.

"THE ELECTRICAL FIRE HAZARD" was the subject of an illustrated talk by Mr. Franklin H. Wentworth, electrician of the Milwaukee Board of Fire Underwriters, at the association rooms in this city on the evening of January 13.

ST. LOUIS NOTES.

ST. LOUIS, Mo., Jan. 13, 1898.

THE KINLOCH TELEPHONE COMPANY completed a deal with the Western Electric Telephone Company, whereby it will connect with about 100 important towns in Illinois, Minnesota, Iowa and South Dakota.

THE FIRST FUNERAL CAR operated in the West will be put on the St. Louis, Belleville & Suburban Electric Railway, now being built between East St. Louis and Belleville. As there are six cemeteries on the road it will pay. The car will be built by the Pullman Company.

BETTER TELEPHONE SERVICE.—On Sunday morning, at 2 o'clock, the old Bell telephone system will be abandoned and the new one placed in operation. After that time all the old telephones will be taken from subscribers, and the work of wrecking the old system will commence.

THE ST. LOUIS ELECTRIC LIGHT & POWER COMPANY has been absorbed by the reorganized Missouri-Edison Company. The deal places the Missouri-Edison Company in almost absolute control of the electric lighting situation. The price paid for the new company is kept secret, but is supposed to be in the neighborhood of $1,000,000. This gives the company eminence of a $9,000,000 investment.

PACIFIC COAST NOTES.

SAN FRANCISCO, Cal., Jan. 8, 1898.

MR. H. C. WYBRO, of the late firm of Wybro & Lawrence, of San Francisco and Los Angeles, Cal., has taken the Pacific Coast agency of the Walker Company, which was formerly held by the Abner Doble Company, of this city. His office is in the *Chronicle* Building.

THE PROPOSITION of the Union Iron Works, San Francisco, to install in the battle ship "Wisconsin," in course of construction at the works, an electric plant for the operating of the turrets and guns and hoisting of ammunition, has been accepted by Secretary Long. The cost will exceed $10,000.

THE SAN FRANCISCO "DAILY EXAMINER" made arrangements for two special direct telegraph wires from this city to Washington, D. C., on January 7—the date of Durrant's execution. News of the action of the United States Supreme Court was received here, and bulletins concerning the execution were posted in Washington City.

THE FORT WAYNE ELECTRIC CORPORATION has sold, through its San Francisco agency, to the Power Development Company, Bakersfield, Cal., 10,000-volt step-down transformers, having a capacity of 100 kilowatts; a 100-kw alternator to the Bellingham Bay Improvement Company, New Whatcom, Wash.; to the Black Diamond Coal Mining Company, Black Diamond, Wash., a 100-kw generator, a 75-kw hoisting motor and two 15-kw pump motors.

THE GENERAL ELECTRIC COMPANY recently sold to the Sugar Beet Company, which is building a large plant in Crockett, Cal., a 40-kw direct-current generator, which will be used to operate motors, etc. Also, to the Oxnard Sugar Beet Company, which is building a factory in Hueneme, Cal., two 75-kw generators and several motors; a 75-kw monocyclic machine for the new electric light plant in Eugene, Ore.; a 50-light arc machine for the town of Ellensburg, Wash. Charles C. Moore & Co., San Francisco, sold a number of engines for the above sugar factories.

CANADIAN NOTES.

OTTAWA, ONT., Jan. 15, 1898.

MR. HENRY HOLGATE, who for several years past has managed the Montreal Park & Island Railway, has resigned his position to take over the management of the West India Electric Railway Company, of Kingston, Jamaica. Mr. Holgate served his apprenticeship with the Northern Railway, and was chief engineer of the Northern & Northwestern Railway from 1884 until 1892.

THE CANADIAN GENERAL ELECTRIC COMPANY is at present installing generators at Bonnington Falls, on the Kootenay River, 30½ miles from Rossland, B. C., for transmission of power to that city. The machinery to be installed will generate 2500 electrical horse-power, which will be sent over a three-wire line to Rossland at a pressure of 20,000 volts. The mines there will be operated largely by electrical power so furnished.

THE CROW'S NEST PASS COAL COMPANY has given out orders for electrical coal mining machinery in the cities of Montreal, Toronto and elsewhere, to the value of $100,000, while the company will also erect about fifty beehive coke ovens at Coal Creek for the purpose of supplying the article to the proposed smelter at Robson, B. C. Mr. Blackmore, chief manager of the company, has visited the leading mining centres in the United States and Canada, with the result that the most improved electric coal cutting machinery will be started in the Pass mines.

ONE OF THE COMMERCIAL SENSATIONS of the year, at Montreal, was created when it was announced that hereafter the Montreal Electric Street Railway would not only pay its dividends quarterly, but would increase them to 2½ per cent. quarterly. The stock is now quoted at 243¼, having risen 7½ points immediately when the increase of dividends to 10 per cent. per annum was made known. It is said by the brokers on the "Street" that this increase means hundreds of thousands of dollars in the pockets of such large holders as Mr. James Ross and Senator Forget.

AN IMPORTANT DECISION has been reached by the Railway Committee of the Ontario Legislature, now in session at Toronto, in passing the bill extending the time for building an extension of the Toronto Electric Railway through the village of East Toronto to Victoria Park. The municipality of East Toronto strongly opposed the bill. The object is ultimately to build to Highland Creek and on to Pickering, Whitby, Oshawa and Bowmanville. At present the road to York does not pay, but by extending the trolley to these Eastern towns the enterprise may become a profitable one.

AN ELECTRIC HORN has just been placed upon the market here which is capable of making a prodigious noise, sounding much like a marine fog horn. This electric horn is the invention of Mr. A. Trudeau, of this city. The need of a horn of this kind suggested itself to the inventor after the late disastrous fire at the Ottawa College, where a serious calamity might have taken place had the fire occurred at night. These electric horns, of a specified size, may be utilized as a morning signal or a fire alarm, for waking pupils in the dormitories of scholastic institutions, or for any other purpose where a whistle might be used where there is an electric current available. The horns can be placed in different parts of a building, and all set tooting at once by turning on the current.

AN INCREASE OF $500 PER DAY in the receipts of the Toronto Electric Street Railway over the figures of a short time ago is a subject of much favorable comment. To the invention of a Toronto citizen, Mr. Michael Power, master car builder of the Toronto Electric Railway Company, there may fairly be given credit to no inconsiderable extent for this improved condition of affairs. Mr. Power is the inventor of the Power track cleaner and digger—a little knifelike device that bobs up and down on the car rails and removes snow, ice and other obstructions. It has worked so effectively that so far this season there has not been any occasion to bring out the ugly sweepers that in the past cleared the tracks from snow, to the disgust of pedestrians and annoyance of people living along the line of railway and the frightening of horses.

A CONTRACT HAS just been entered into between the Department of Public Works of Canada and the Ottawa Electric Company, which covers the lighting of all the public buildings in Ottawa by electricity. At present there are already some 2000 electric lights in the Parliament Buildings alone. These are operated from an electric light station belonging to the Government. It is proposed to close this station, and the circuits will then be connected with the system of the local company. The remainder of the Parliament Buildings as well as the departmental and other public buildings, are lighted by gas, for which electricity will be substituted. The change will effect a saving of $13,000 per annum, as compared with the cost of lighting by gas. The Ottawa company has five electric light stations in the city, four of them using water as a motive power. Much unfavorable criticism is occasioned by the determination of the department to pass over Canadian firms and purchase American fire appliances, operated by electrical energy, for the Government Buildings. Deputy Minister Gobeil, however, declares that the Worthington pump is the best in the world, and these will therefore be placed in the several buildings.

French Note.

(From Our Own Correspondent.)

PARIS, France, Dec. 31, 1897.

TRACTION IN PARIS.—Notwithstanding that Paris is not as extensive as London and that it measures only about 5 or 6 miles in diameter, and notwithstanding that it is a city shut up inside of its fortifications, there is no less need of a traction service to connect the various quarters. It is hurtful to our pride, but it must be said that the omnibus service and the tramway services which now move through the streets of the capital are utterly insufficient. As is the case all over France the service is a monopoly and the companies declare their inability to do anything more to relieve the situation under the rate of charges which is imposed upon them. It results from this that the number of vehicles is very limited, and that during the rush hours in the morning and in the evening, that is to say at the hours when such a service is the most necessary, all are filled and intending passengers have the pleasure of waiting in the mud, perhaps in the rain, anywhere from ten to fifteen minutes for the arrival of an omnibus and tram car which comes along full. We hope to have, after a brief delay, a metropolitan system, but it is not wise to count too fully upon it. Some months ago the municipal council voted for the construction of an underground metropolitan railway to be operated by electric traction, but since the municipal parliament does not view this proposition favorably, and since the council is rather hard-headed in the matter, it is impossible to say when the conflict between the two bodies will cease. If one looks below the surface a little it is not difficult to see certain probable interests, particularly those of the great railway companies, who wish to turn this metropolitan system to their profit and thus enable themselves to penetrate nearer and nearer to the centre of the city. In this way the Compagnie d'Orleans installed itself at the Quai d'Orsay, and the same company reaches almost up to the Boulevard St. Michel and will in a little while be extended up to the principal line along the Seine. There remains consequently to the Parisians only a hope for electric traction of the tramway species. It is well understood that Paris does not desire overhead trolley systems. They are not æsthetic, and with that word anybody can stand Parisians on their heads sooner than make them adopt something practical but not elegant to look at. One needs to go as far as Versailles to find the first sign of an overhead trolley road. There is nothing left but underground conduit systems. These are very expensive, and consequently there has been adopted, as a sort of experiment, the most complicated system, as well as the cheapest. I refer to the Glaret-Villenmier, which, as everybody knows, is in operation only at Paris. On this account there is no place for further experiment upon the system. Beyond this there are only accumulator tramways. Of these there is but a single line in Paris, and its affairs do not appear to be in that brilliant shape which would make certain the extension of its lines. Meanwhile it should be said that a strong irritation is felt at this state of things. The authorities feel it, and the omnibus company has endeavored, by establishing new routes and running its vehicles under more frequent headway, to keep down the public demand for better traction. We seem to be yet far from the undertaking or the finishing of electric traction projects and, notwithstanding that Paris is always boasting of its elegance and of its renown as the capital of the civilized world, it does not seem to reach at its first trial complete perfection in this matter, and practically makes only ridiculous attempts. They experiment, first trying one system, then another, a third, a fourth—to finish up by not adopting any. There are now in Paris no less than seventeen different traction systems! Everything is represented here—steam, compressed air, petroleum, horses, accumulators, underground conduits—it is a museum of modern and ancient inventions, but they form by no means a system of regular and proper car service. These things are not really practical railway systems, rapidly moving and establishing genuine communication between the different quarters of the city. In a forthcoming letter I will take up the subject of the suburban lines, which have been projected in great number on account of the Exposition, and which will be nearly all operated by electricity. It is to the suburbs that we must look, as in the matter of electric lights, for the construction of the proper systems of tramway traction for which we have so long waited.

General News.

New Incorporations.

THE STORY ELECTRIC COMPANY, Chicago, Ill., has been organized, with a capital stock of $10,000. W. H. Utt, G. W. Oberlander and Eric Winters are interested.

THE MORRISON TELEPHONE COMPANY, Greenfield, Ind., has been organized. The directors are: J. G. McCord, William Morrison and S. Morrison. Capital stock, $5,000.

THE CARSON ELECTRIC LIGHT COMPANY, Carson City, Ia., has been incorporated, with a capital stock of $5,000. The incorporators are: William Hotze, David Snapp and John Reid.

THE STANDARD ELECTRIC LIGHT & POWER COMPANY, Dallas, Tex., has been formed, with a capital stock of $100,000. The incorporators are: E. A. Ellis, L. Ashton and C. H. Alexander, of Dallas.

THE KERRVILLE ELECTRIC LIGHT, HEAT & POWER COMPANY, Kerrville, Tex., has been formed, with a capital stock of $10,000. The incorporators are: Charles Schreiner, A. C. Schreiner and L. A. Schreiner.

THE PENINSULA RAILWAY COMPANY, Newport News, Va., has been incorporated for the purpose of building an electric railway between Newport News and Old Point. Among the incorporators are: W. A. Post, Frank Lee, and others.

THE MIDDLETOWN GAS & ELECTRIC LIGHT COMPANY, Middletown, Ohio, has been incorporated, with a capital stock of $50,000. The incorporators are: Charles E. Denny, W. F. Simpson, W. O. Barnitz, T. E. Reed, and others.

THE COLONIAL ELECTRIC COMPANY, New York, N. Y., has been incorporated, with a capital stock of $25,000, to operate in Greater New York. The directors are: Garrett S. Odell and O. H. Cheney, New York, and Horace S. Andrews, Brooklyn.

THE CLOOS ELECTRICAL ENGINEERING COMPANY, Milwaukee, Wis., has been formed for the purpose of manufacturing and selling the Cloos safety, economical and electrical devices. Herman W. Falk is president, and Jacob Cloos vice-president.

THE ELKHART COUNTY TELEPHONE COMPANY, Elkhart, Ind., has been incorporated, with a capital stock of $5000, for the purpose of operating telephone exchanges in Elkhart and Lagrange Counties. The general office of the company will be at Middlebury.

THE WARD ELECTRIC LIGHT & POWER COMPANY, Denver, Col., has been organized, with a capital stock of $15,000. The company will operate and maintain an electric light plant in Boulder. Among those interested are C. W. Betts, J. A. Kilton and A. W. Olsen.

THE WHEELER ELECTRIC & MANUFACTURING COMPANY, Dayton, Tenn., has been incorporated for the purpose of manufacturing electrical goods and sundries. The officers of the new company are: J. T. Dean, president; W. E. Wheeler, secretary and treasurer.

THE ELLWOOD & NEW CASTLE TRACTION COMPANY, Ellwood City, Pa., has been formed for the purpose of building a railway 13 miles in length. The officers of the new company are: H. N. Marshall, president; J. F. Corland, J. B. Phillips and S. A. Wortman.

THE BANGOR ELECTRIC CLOCK COMPANY, Bangor, Me., has been organized. Among those interested are: Arnold A. Rand, Boston, who is president of the new company; Joseph S. Smith, of Bangor, vice-president and manager, and Walter J. Dudley, of Summerville, superintendent.

PEAK ISLAND WATER & LIGHT COMPANY has been organized at Portland, Me., for the purpose of acquiring and operating water works and light plants. The officers are: Richard K. Gatley, president, Portland, Me.; Charles C. Douglass, treasurer, Portland, Me. Capital stock, $50,000.

THE WEST ORANGE ELECTRIC LIGHT & POWER COMPANY, West Orange, N. J., has filed articles of incorporation, with a capital stock of $100,000. The incorporators are: Frank Brewer and Albert P. Condit, West Orange; John O'Rourke, Orange; Jay Ten Eyck, Newark; Alfred F. Skinner, Franklin and James C. O'Brien, South Orange.

THE HUDSON RIVER & LONG ISLAND SOUND RAILROAD COMPANY, Yonkers, N. Y., has been incorporated for the purpose of building an electric railway from Yonkers to Pelham Manor. The directors of the new company are: Charles C. Bassett, Washington; James F. Secor, Pelham Manor; William L. Stout, Elizabeth; Seward Baker, New York.

THE TELEGRAPH AND TELEPHONE.

FARGO, N. DAK.—A petition has been granted to the City Council praying for relief for inefficient telephone service.

SAGINAW, MICH.—The Bell Telephone Company has cut its rates to meet the competition of the Valley Telephone Company.

MENOMINEE, WIS.—The Wisconsin Valley Telephone Company has built about 600 miles of line in Northwestern Wisconsin.

CLINTON, IA.—The Iowa Telephone Company is busily engaged in constructing a telephone line from this place to Delmar.

FAIRMONT, MINN.—The Fairmont Telephone Company has declared a dividend of 20 per cent. on its business for the past year.

TIFFIN, OHIO.—The telephone line between Tiffin and the villages east and southeast was formally opened a few days ago. The line works very satisfactorily.

ST. PAUL, MINN.—The Northwestern Telephone Exchange Company has paid to the State Treasurer $10,024.65, the amount of the 3 per cent. tax on its gross earnings on 1897 business arising within the State.

CENTRALIA, MO.—A new telephone system between Columbia and this city has been completed and is now in working order. Connections are now possible with all parts East and West on the Wabash Railroad.

ST. JOSEPH, MO.—At the annual meeting of the stockholders of the Citizens' Telephone Company, officers were elected for the ensuing year as follows: Dr. J. J. Newell, president; M. M. Riggs, vice-president; George A. Morse, secretary; and R. S. Frazer, treasurer.

ANN ARBOR, MICH.—The Michigan Bell Telephone Company has offered to put in a telephone, free of charge, at the residence of every business man in this place who will use an instrument in his store. This move seems to be with the object of running the new State Company down.

COUNCIL BLUFFS, IA.—The long-deferred matter of taxing telegraph and telephone tolls was brought to a crisis at the last meeting of the City Council by the adoption of a majority report from the committee appointed to investigate the matter, recommending that such an ordinance be passed.

PARIS, ILL.—Telephone connection between this place and Terre Haute is an assured fact, and the work of constructing the line will begin at once. In consideration of the franchise, this city is to receive 25 per cent. of the gross earnings of the company. Mr. P. G. Farrow is the promoter of the enterprise.

DELAWARE, OHIO.—The Citizens' Telephone Company has completed its new plant in this city, and begun service with 223 subscribers. Competition has reduced the price of telephone rental about one-third. The new company is constructing a line to Centerburg, where it will connect with other local companies in Central Ohio.

FT. SCOTT, KAN.—The Missouri & Kansas Telephone Company is pushing the construction of its long-distance line to Wichita. An independent line, which will connect with the Mutual Company's line at this place, is being constructed from Humboldt and Iola. It is now within 10 miles of the city, and will be finished in a few days.

PEORIA, ILL.—The Fulton County Telephone Company is trying to secure an entrance to Peoria. The company's line now connects thirty-five towns in Fulton County, and has outside lines to Bushnell, Havana and Beardstown. At the latter place connection is made with the lines of another company, reaching Jacksonville and other places.

LANSING, MICH.—The Michigan Bell Telephone Company is endeavoring to have the valuation of its property reduced to last year's figures. The State Board increased the valuation to $900,000 as the basis for levying the 3 per cent. tax this year, but the company objects to the increase, which amounts to about $60,000. The matter is now under advisement.

DOWAGIAC, MICH.—The Central Telephone Company has completed arrangements for connection between the Kalamazoo and Chicago line and the Gilliland telephone exchange. The line will probably reach this city in three weeks. From Dowagiac it will be extended to Niles and Buchanan, and also to various cities in Northern Indiana and in this part of Michigan. It will be operated entirely independent of Bell interests.

MT. VERNON, OHIO.—A meeting of the representatives of independent telephone companies was held here recently, when it was decided to improve the long-distance service. To this end special copper wire will be strung and metallic circuits used to connect the important exchanges, including Coshocton, Newark, Delaware, Mt. Vernon, Wooster, Massillon, and other places. The work will be commenced at once and pushed with vigor.

MT. CLEMENS, MICH.—Mr. James G. Tucker, the receiver of the Detroit & River St. Clair Railway, now in the course of construction between Chesterfield and Marine City, has contracted with the new State Telephone Company for a private telephone line along the railway, to be used for dispatching purposes. The telephone company will also maintain a toll line at the various towns on the road, with branch lines connecting with other places. It is expected that the line will be in operation by February 15.

SPRINGFIELD, ILL.—Retaliation on the telephone company of Chicago for forcing slot-machine telephones into drug stores against the wishes of the druggists has appeared in the Legislature in the form of a revenue bill, recently introduced, which provides for a tax of $50 a year on every slot device operated by a telephone company, and $10 a year on other telephones. It is stated that this bill is the result of resentment aroused among Chicago druggists, who have been compelled to increase their telephone expenses, accept a slot device and lose the opportunity of accommodating their customers.

MINNEAPOLIS, MINN.—An extraordinary use of the long-distance telephone was made a few days ago when Mr. Charles J. Glidden, president of the Traders' National Bank, of Lowell, Mass., who was in this city, presided over a meeting of the bank directors in Lowell, using for the purpose the long-distance wires. Mr. Glidden called the meeting to order over the 'phone, and transacted the business in the usual manner. It is stated that he readily recognized the voice of each director as he spoke into the long-distance instrument. The line was made up of eight copper metallic circuits, and was over 1,500 miles in length. This is believed to be the first business meeting ever held by the use of a telephone over so great a distance.

ELECTRIC LIGHT AND POWER.

TACOMA PARK, MD.—The citizens are contemplating the erection of an electric light plant.

NEW CARLISLE, IND.—The Town Council has accepted the plans for the proposed electric light plant.

MADISON, WIS.—The Madison Gas & Electric Light Company has declared a regular semi-annual dividend of 2 per cent.

OCALA, FLA.—Arrangements are being made for constructing an electric light plant, for which $16,000 in bonds were voted in December.

HOMER, ILL.—Mr. J. D. Wallace, of Champaign, has been granted a five-year franchise to erect an electric light plant in this place, the same to be completed by May 1 next.

SYRACUSE, N. Y.—The Syracuse Storage Battery Company will remove its plant to Clyde, where it will erect a building adjoining the station of the Clyde Electric Light Company.

MONTGOMERY, PA.—The Montgomery Electric Light & Power Company has opened for business, the service having been initiated with a celebration on the part of the citizens of the place.

CLYDE, N. Y.—The Clyde Electric Light Company is preparing to lay the foundation for the enlargement of its station to accommodate a 250-hp Corliss engine and a 150-hp Fitzsimmons boiler.

MACON, GA.—An order has been granted in the United States Court for the sale of the Brunswick Light & Water Company's plant, Brunswick, Ga. The property will be advertised and sold in accordance therewith.

AVON, N. Y.—The Avon Electric Company has chosen the following named gentlemen as officers: President, Dr. Cyrus Allen; vice-president, Alva Carpenter; secretary and treasurer, Dr. Irving Allen; superintendent, Charles Whiting.

WASHINGTON, PA.—At the annual meeting of the stockholders of the People's Light & Heat Company, the following named gentlemen were elected officers: Samuel Hazlett, president; Col. J. B. R. Streator, secretary; George L. Caldwell, treasurer.

NORTH TONAWANDA, N. Y.—Two fires occurred in the plant of the Tonawanda Lighting & Power Company within a few hours of each other on January 5, and on both occasions the city was plunged into temporary darkness. The machinery was slightly damaged.

LANSINGBURGH, N. Y.—At the annual meeting of the Beacon Electric Light Company, the following named officers were elected for the ensuing year: President, J. George Kaelber; vice-president, Samuel Bolton, Jr.; secretary, Gilbert P. Williams; treasurer, William M. Lea.

WASHINGTON, D. C.—Secretary of the Navy Long, in a letter to the chairmen of the Naval Committees of the Senate and House, urges appropriations for repairs and construction at the Naval Academy at Annapolis. Electric wiring is one of the subjects specified as needing attention.

HOLLIDAYSBURG, PA.—The stockholders of the Holidaysburg Electric Light & Power Company have chosen officers for the ensuing year as follows: President, James W. Gromiller; vice-president, W. H. Markland; secretary and treasurer, John W. Cliber; board of directors, W. H. Markland, James W. Gromiller, John W. Goodfellow, O. M. Irvine and J. Lee Plummer.

COLUMBUS, GA.—The Columbus Power Company, which has just been organized in this city, owns the famous "Lover's Leap" water power, just north of the city, and will at once begin to build a dam across the river and erect a plant for furnishing electric power for manufacturing industries. The officers of the company are: H. M. Comer, president; G. G. Jordan, treasurer. The capital stock is placed at $200,000.

NEWARK, N. J.—The Newark Electric Light & Power Company has appealed to the State Board of Taxation to reduce the valuation on its personal estate, as fixed by the Newark Board of Assessment and Revision of Taxes. The company claims that the assessment is equal to the actual value of its property, real and personal, that is subject to taxation in Newark.

STONINGTON, CONN.—Plans are now being made to light the village of Mystic and the borough of Stonington by electricity. A company was formed for this purpose several years ago, and a charter obtained. Mr. T. C. Perkins, electrical engineer, of Hartford, is at present looking over the ground and making estimates of the cost. It is calculated that the plant will cost about $20,000.

The Electric Railway.

GENEVA, N. Y.—It is proposed to extend the Penn Yan, Keuka Park & Branchport Electric Railway to this city.

ROCKAWAY BEACH, L. I., N. Y.—It is stated that a trolley line will be built to this place by the Long Island Railroad Company.

BALDWINSVILLE, N. Y.—The Onondaga Lake Railroad Company will build an electric road, connecting this village and Syracuse.

METUCHEN, N. J.—There is reason to believe that the line of the Brunswick Traction Company will be extended from Metuchen to Plainfield in the spring.

CINCINNATI, OHIO.—Arrangements are being made for the construction of an electric road from Newport to Ft. Thomas, by the way of Grand Avenue.

ORANGE, N. J.—The North Jersey Traction Company will petition the West Orange Township Committee for a franchise to build a line through that township.

AMBLER, PA.—It is proposed to construct a trolley road from here to Norristown. John S. Buchanan and A. K. Thomas, of Ambler, Pa., are interested.

OMAHA, NEB.—The Omaha Street Railway Company will expend $100,000 in preparing to carry the visitors at the exposition next summer. Engine, generators and boilers will be purchased.

BRIDGEWATER, MASS.—The Brockton, Bridgewater & Taunton Street Railway Company has applied for the necessary franchises for the extension of its line from Bridgewater to New Bedford.

MILWAUKEE, WIS.—It is stated that the dummy road out Wells Street, which is to be converted into an electric road, will be extended to the county farm buildings, provided a right of way is granted by the town of Wauwatosa.

MERIDEN, CONN.—Mr. E. D. Robbins, vice-president of the New England Railroad Company, states that the third-rail electric service will be extended from New Britain to Bristol. It is expected that the cars will be running by April 1, if not before.

NEWARK, N. J.—The consolidation of the Newark and South Orange Railroad Company and the North Jersey Traction Company was effected on January 13. The new company will control all of the roads in Essex County, except those of the Consolidated Traction Company, with which it is in harmony. The South Orange system runs from Maplewood, through South Orange and Vailsburg, to the foot of Hamburg Place, on the eastern border of Newark, running for some distance over the Consolidated tracks in Market Street, Newark. The North Jersey Company owns the line from Montclair, through Verona to Caldwell, and another line on Springfield Avenue, from Hilton to Maplewood, as well as a section of its Caldwell line in Glen Ridge. A number of extensions of these lines are in contemplation, and the most important, outside of the connection through Montclair, is the extension of the road from Irvington to Hilton, and from Maplewood to Milburn and Springfield.

Personal Note.

MR. O. LOUIS KUEHMSTED was born in Oshkosh, Wis., thirty-two years ago, and was educated at Cornell University, from which institution he was graduated in 1892, with the highest honors in mechanical and electrical engineering. After leaving college he accepted a position with the Thomson-Houston Electric Company, at Lynn, Mass., in its expert department. He was later on engaged in installation work for the Mather Electric Company. In the fall of 1892 he took charge of the electrical engineering department of the University of Illinois, organizing the course and graduating the first class. He resigned this position to superintend the construction of the Ithaca, N. Y., street railway and lighting plant. After this he installed and operated several large plants in the mining districts of Montana. In September, 1895, he accepted the position of general manager of the Charles E. Gregory Company, Chicago, Mr. Gregory himself selling out his interest and retiring from the concern. Mr. Kuehmsted's wide experience in the electrical field, and his thorough familiarity with every detail of design, manufacture, installation and operation, have been invaluable to him in taking charge of the present business. He possesses untiring energy and exceptional business ability, and under his management the C. E. Gregory Company's business has prospered and become firmly established in the community.

O. Louis Kuehmsted.

Obituary Note.

MR. BURR K. FIELD, vice-president of the Berlin Iron Bridge Company, East Berlin, Conn., died at his home in that city on January 12, of pneumonia. Mr. Field was born forty years ago and was graduated from the Sheffield Scientific School in 1877. He was a civil engineer of considerable note.

Trade and Industrial Notes.

THE CENTRAL ELECTRIC COMPANY, Chicago, has favored us with one of its desk calendars. It is of the easel form, with twelve removable cards, one for each month, and is of neat design.

WE ACKNOWLEDGE with thanks the receipt from the Joseph Dixon Crucible Company, Jersey City, N. J., of a box containing a varied assortment of lead pencils, erasers, etc. They will be very useful to the editors.

MESSRS. THORPE, PLATT & CO., 97 to 103 Cedar Street, New York, have just issued a booklet on the subject of standard high-pressure fittings and flanges. The book also contains a good deal of engineering information.

MR. CHARLES WIRT, Philadelphia, Pa., has printed a pamphlet for the Kanagawa Electric Light Company, of Japan. It is intended for distribution in that country, and is printed in English. This company represents Mr. Wirt's brush interests in Japan.

A HANDSOME VIEW of the works of the National Carbon Company, Cleveland, Ohio, appears on a calendar issued for the benefit of its customers. The shop buildings, with their long bays, their ample monitors and many stacks, indicate a thriving business.

THE BOSSERT ELECTRIC CONSTRUCTION COMPANY, of Utica, N. Y., has issued a calendar with perspective views of its steel junction and outlet boxes and ironclad panels and terminal boards. These boxes are drawn from sheet steel, and are arranged for any desired combination of conduits.

THE E. G. BERNARD COMPANY, Troy, N. Y., has issued a unique calendar for 1898, which will be appreciated by those receiving a copy. In the centre is a female figure, and in the right-hand margin there is a small thermometer, which will enable one to ascertain the temperature, as well as the day of the month.

MESSRS. HUEBEL & MANGER, Brooklyn, N. Y., in looking up the record of their alarm and signal bells, found that in hotel fires and railroad accidents their bells were lacking in the equipment for protection. The majority of hotels and railroads of the country, however, have these bells installed in their alarm systems.

THE G. F. BRUNT PORCELAIN WORKS, East Liverpool, Ohio, has issued a very handsome calendar for 1898. It is different in artistic merit from the general run of calendars. There are six sheets, with two monthly calendars to a sheet. Each sheet contains a very fine reproduction of a figure in water colors. It is a work of art.

THE ELECTRIC APPLIANCE COMPANY, Chicago, states that it is carrying a stock of iron line material that will enable it to make prompt shipments of anything up to a carload, and yet its capacity has been taxed on these goods. The company states that its stock is still being kept up, and that customers wanting iron construction material promptly from Chicago stock will not be disappointed.

THE SESSIONS FOUNDRY COMPANY, Bristol, Conn., has recently secured a number of important contracts for iron castings for the coming year, among them being a renewal of its previous contract with the Providence Steam Engine Company, manufacturer of the Green engine. This latter contract involves some heavy work, and when business is good amounts to many tons per day. The Sessions Foundry Company's business for the past year has been the largest in its history.

THE MANY APPLICATIONS of the Stow flexible shaft are described and clearly illustrated in a catalogue just issued by the Stow Manufacturing Company, Binghamton, N. Y. The combination of the flexible shaft and electric motor constitutes a very efficient apparatus for portable drilling, tapping, reaming, etc., and for electric railway construction it is very useful, enabling the contractor to perform a much larger amount of work in a given time. The drill is available for any kind of outdoor work on electrical railways.

LADDERS FOR ELECTRICAL WORK.—A combination of lightness and strength in ladders is shown in all the bent-rung ladders and step ladders made under patents by the Indiana Ladder Company, of Indiana, Pa. Electrical companies and mechanics have generally discovered the marked advantages in these improved ladders, and they are rapidly driving the old-style ladders out of the market. They cost no more than the latter, they are far stronger, and their lightness saves labor, often enabling one man to do work that formerly required two. The company will send a descriptive catalogue on request to those interested.

THE ARMORITE INTERIOR CONDUIT COMPANY, Pittsburg, Pa., is manufacturing a wood-lined tube intended for conveying salt water, sulphur, etc. A wooden tube thoroughly treated to prevent the liquid from penetrating it is forced inside an ordinary iron or steel pipe. The inside pipe can be cut any thickness, and is made to fit perfectly tight in the metal pipe with flush joints, and coupled up precisely in the same manner as lined pipe. It is

claimed that this method of construction avoids the deterioration of metal pipes, which has heretofore been a prolific cause of trouble and expense.

THE WALKER COMPANY is now building at its Cleveland works a 1600-kw direct-connected generator for the Union Railway Company, of New York City. This, with the two now being completed for the Brooklyn Heights Railroad Company, will make three of these 1600-kw machines finished in as many months. In addition to this generator for the Union Railway Company, the Walker Company is building for the same company forty double No. 4-A street railway equipments. The equipments are to be fitted with the new type "S" solenoid blow-out controller. The current for these motors will be fed to the line from a Walker switchboard, now being built at New Haven. The Metropolitan Street Railway, of Kansas City, which is now operated by a 1600-kw Walker generator, is about to increase its plant by the addition of a generator of 1200-kw capacity, and as a contrast to these immense machines it may be mentioned that the company is building a 25-kw lighting generator for Mr. J. J. Astor's new yacht. The foreign shipments during the next few months will include 100 double 3-S street railway equipments, with 200 controllers, for Dresden, Germany; six double 3-N equipments, with type "S" controllers, and two double 3-N equipments. Besides these railway motors and accessories, there will be one 150-kw belted railway generator, with its switchboard, and a 75-kw belted booster for Japan, also with a switchboard. This makes over 7500 horse-power in street railway motors alone that are being built at the Cleveland works, to say nothing of the horse-power output in generators.

Business Notice.

NEW FACTS ABOUT SOUTH DAKOTA.—To enable the farmers in the Eastern States to pass the long winter evenings in an entertaining and instructive manner, the Chicago, Milwaukee & St. Paul Railway Company has recently published, for free distribution, a new pamphlet, finely illustrated with pictures which will delight the eyes of Eastern farmers, and containing letters from their brethren in South Dakota descriptive of their experience while tilling the soil and raising cattle, sheep and hogs in the "Sunshine State." This pamphlet is well worth reading through from cover to cover. It will be sent free, if you will send your address to either H. F. Hunter, Immigration Agent, 291 Dearborn Street, Chicago; or to Geo. H. Heafford, General Passenger Agent, Old Colony Building, Chicago, Ill.

Illustrated Record of Electrical Patents

UNITED STATES PATENTS ISSUED JANUARY 11, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

596,989. ALARM DEVICE; W. E. Downing, Des Plaines, Ill. App. filed April 20, 1897. In an alarm device, the combination of a float, a battery and alarm device in circuit, a contact device interposed between the said float, battery and alarm device, and comprising a base having two binding posts in circuit with said battery and alarm, a contact plate pivoted to one binding post and adapted to contact with the other post, a spring to normally maintain the contact plate out of contact, a pivoted lever to move the contact plate against the tension of the spring, and a cord or wire connection between the said lever and float.

596,993. MAIL-COLLECTION SYSTEM; D. A. Gray, Boston, Mass. App. filed June 3, 1897. The combination of an electric circuit, a letter box having an inner and an outer door, a lock carried by the inner door, which is included in said circuit, a manually operated lock for the outer door, a keyboard located at the central station, which is also in said circuit, an indicating device at the central station, which is also included in said circuit, and means for operating said devices from the letter boxes.

597,002. GRAPHITE RHEOSTAT; E. W. Jewell, Chicago, Ill. App. filed May 8, 1897. In a rheostat, the combination with an insulating base, of a uniformly graded graphite resistance mounted thereon, a contact arm adapted to travel over and make firm electrical connection with said graphite resistance, binding posts in electrical connection with each end of said graphite resistance, binding posts in electrical connection with the said contact arm and one end of said graphite resistance, respectively, and auxiliary sockets in said binding posts adapted to receive independent switch plugs or connectors.

597,003. APPARATUS FOR STATING TIME AND NUMBER OF TELEPHONIC CONVERSATIONS; E. Konsanke, C. Fuhr and B. Krausse, Wilmersdorf, Germany. App. filed July 5, 1895. In a telephone system, the combination of a registering time mechanism, means controlled by the movement of the parts at the calling and called subscribers to a position for conversation for starting the register, and means controlled by the restoration of the parts at the calling subscribers for stopping the register.

597,018. METHOD OF REGULATING SPEED OF SERIES ELECTRIC MOTORS; H. F. Parshall, London, England. App. filed April 5, 1897. The art of regulating the speed and torque of a series electric motor, which consists in shunting the field coils of the motor by a source of E. M. F., imparting energy from line to the source of E. M. F. when the current is large, and taking energy therefrom to maintain the field when the line circuit is cut down by the counter E. M. F. of the motor.

597,036. ELECTRIC RAILWAY CONDUIT SYSTEM; R. F. Thompson, Alexandria, La. App. filed July 13, 1897. In an electric railway conduit system, consisting of a conduit provided with air and water-tight chambers, one on each side of the trolley slot, and secured to the yokes; said chambers being provided with insulators, trolley wires, partitions and curved projections.

597,052. TELEPHONE EXCHANGE SYSTEM; W. W. Dean, St. Louis, Mo. App. filed Sept. 22, 1897. In a telephone exchange system, the combination with two telephone lines of switching apparatus at the exchange for uniting said lines for conversation, a signal receiver at one of said stations, a signaling generator for operating the same, a switch hook at the latter station for the receiver, adapted to occupy one position through the influence of the receiver when supported thereon, and an alternative position when the receiver is removed, an automatically operated clearing-out indicator at the exchange adapted to be associated with the called-subscriber's line by said switching apparatus, a circuit including or adapted to include said clearing-out indicator, anad means for changing the condition of said circuit to cause the clearing-out indicator to present a signal, the switch hook being adapted to control said means and partially to effect an operative change in the condition thereof when actuated upon the removal of the telephone said switch hook being further adapted to complete the operative change in the condition of said means when restored to its normal position through the influence of the receiver when replaced thereupon, whereby the condition of the clearing-out indicator circuit is changed to operate the clearing-out indicator.

597,053. TELEPHONE EXCHANGE SYSTEM; W. W. Dean, St. Louis, Mo. App. filed Sept. 22, 1897. In a trunk-line telephone system, the combination with two switchboards, of a plurality of subscribers connected with each of said boards, signal receivers at the subscribers' stations, a trunk line extending between the boards, switching apparatus at one of said boards for uniting subscribers for conversation, a calling generator, means for including the same in circuit with the signal receiver at a called-subscriber's station connected with the latter board, electromagnetic means for removing said generator, apparatus at the subscribers' stations connected with the latter board, each being adapted when its station is the called station to operate the latter, means to remove the calling generator from circuit with the signal bell, and a conductor normally connected with the trunk line adapted to alter the operative condition of the electromagnetic means and to be connected therewith by the switching apparatus upon the manipulation thereof to connect a subscriber whose telephone line extends to the latter board with the trunk line extending to the other board, whereby the generator is disconnected immediately upon the establishment of connection with the trunk line.

597,054. TELEPHONE SYSTEM; W. W. Dean, St. Louis, Mo. App. filed Sept. 22, 1897. In a telephone exchange system, the combination with a plurality of subscribers' stations, of telephone lines extending therefrom to the exchange, signal receivers or bells at the subscribers' stations, a cord circuit for forming a continuation of a telephone line, a connecting plug adapted to connect said cord circuit and telephone line with another telephone line, a ringing switch, a calling generator, means for connecting the generator with and disconnecting it from the ringing switch, said plug being adapted to operate or control said means to connect the generator with the ringing switch when it is manipulated to connect the second or called-telephone line with the cord circuit, said ringing switch being adapted in its normal idle position, and when thus connected with the generator to direct-calling current to the bell at the called-subscriber's station, means for actuating the switch to remove the generator from circuit with the bell and apparatus at each subscriber's station, each being adapted when its station is the called station to operate the latter means.

597,062. CALLING DEVICE FOR TELEPHONE EXCHANGE; A. E. Keith, J. and C. J. Erickson, Chicago, Ill. App. filed Aug. 20, 1896. A transmitter for sending electric impulses over a plurality of lines comprising a step-by-step circuit breaker to send a series of impulses, a circuit changer for directing the currents over a selected line, and a connection between the circuit breaker and the circuit changer constructed to actuate the circuit changer each time that the circuit breaker is operated through its course.

597,090. DYNAMO ELECTRIC MACHINE; J. Sohlman, Wiborg, Finland. App. filed May 22, 1897. In an alternating-current generator, the combination with an even number of stationary pairs of pole pieces, projecting radially from a casing, each pole piece surrounded by an induction coil, while every two of said pole pieces are surrounded by an exciting coil, of a rotating core, placed centrally in the casing and arranged in such a manner in relation to the pole piece that the magnetism is fully reversed in the core during its rotation.

597,128. FIRE ALARM; G. A. Townsend, Utica, N. Y. App. filed May 18, 1897. An alarm comprising a base plate adapted to be secured to a suitable support, and provided with standards which are connected at the tops or outer ends by a curved plate, a spring secured to the under side thereof, said standard being provided with flanges, an arm pivotally mounted in said flanges, a supplemental plate secured to the said standard, an angular support soldered thereto on one arm, of which the free end of said pivoted arm is adapted to rest, the solder forming the connection between said

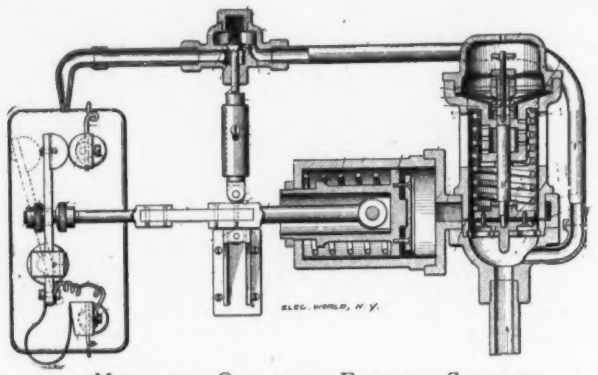
plates, being adapted to fuse at a predetermined degree of heat, an oblong plate secured to and insulated from the base plate, and provided at one end with an arm, a binding post mounted thereon, said plate being provided at the opposite end with an angular arm adapted to engage the aforesaid arm when not engaged by the said angular arm, a binding screw secured to one of said flanges and wires connecting said binding screws with a battery and with an electric arm.

597,137. STATIC-INDUCTION ELECTRIC GENERATOR; A. L. Bogart, Jamaica, N. Y. App. filed May 5, 1897. A cylinder for an electrical generator of the static induction or influence type, made of insulating material, a removable plug therefor of similar material, metallic contact springs carried by said plug, and adapted to contact with the stationary number of the device.

597,140. INSULATING TROLLEY HANGER; E. J. Cook, Cleveland, Ohio. App. filed Dec. 2, 1897. The combination with the body perforated and recessed, a screw-threaded projecting portion on said body having a reduced neck, and a cap screwed on said body, an insulating bolt having an enlarged head fitted into said body and recess, a flexible washer between said bolt and cap, adapted to be clamped by said clamp, and a series of malleable projections extending entirely around the lower edge of said cap, so that one or more of said projections may be bent inwardly to clinch said neck in any position of adjustment of said cap.

597,150. MEANS FOR OPERATING ELECTRIC SWITCHES AND EXTINGUISHING SPARKS THEREOF; J. B. Knudsen, Chicago, Ill. App. filed June 16, 1897. The combination with contact terminals and with a switch for controlling the passage of current through said terminals, of means for operating said switch, comprising an air cylinder and a piston suitably connected with said switch, and a regulating valve connected with said air cylinder, whereby when said regulating valve is shifted by the pressure of air from the air tank, or reservoir, air will be admitted to said cylinder to cause the shifting of said switch.

597,156. ELECTRIC RAILWAY MOTOR; C. J. Van Depoele, Deceased; C. A. Coffin and A. Wahl, Administrators. App. filed June 11, 1890. As a



No. 597,150.—Means for Operating Electric Switches and Extinguishing Sparks Thereof.

means for controlling electric motors, and in combination, a circuit-interrupting device adapted to interrupt the circuit of the current supply at a number of points simultaneously, and a current-changing device effecting relative changes in the circuits of the translating device during the time that the current is so interrupted.

597,159. AUTOMATIC TENDER FOR TROLLEY OPERATING ROPES; C. F. Wilson, Brooklyn, N. Y. App. filed Oct. 1, 1896. An automatic tender, comprising a suitable support, a spring-actuated reel mounted on the support, a dog carried by the reel and mounted to swing outwardly into engagement with the support, and a dog-regulating spring consisting of a bar or plate spring carried by the dog, and means for adjusting the free end of the spring in a lateral direction to increase or diminish its retarding effect upon the dog.

597,172. FILAMENT FOR INCANDESCENT LAMPS; E. F. Von Wilmowsky, Boston, Mass. App. filed Sept. 3, 1896. A filament or conductor for incandescent lighting composed substantially of boron.

597,180. ELECTRIC TRANSFORMER; J. F. Gates, Pittsburg, Pa. App. filed Jan. 29, 1897. A transformer or converter, having a primary and secondary coil, a rack and gear for moving a primary coil in contact with the secondary coil, a stationary central tube, having a filling of magnetic wires, connections between the primary coil and the main-circuit wire, and connections between the secondary coil and the object to be changed.

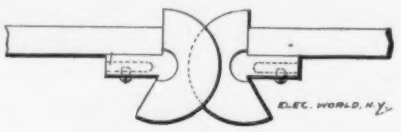
597,198. AUTOMATIC-STOPPING MECHANISM FOR ENGINES; V. E. Hunter, Cleburne, Tex. App. filed June 24, 1897. The combination of a throttle valve, having a rotatable stem and a disc or wheel thereon, a cord and weight connected to said wheel for rotating it and closing the throttle valve, an electromagnet, an armature therefor, a slide rod connected to said armature and adapted to engage and hold the wheel on the throttle-valve stem, a belt, and means continuous to said belt for completing the electrical circuit in which the magnet is located when the belt is shifted.

597,202. ELECTRIC RAILWAY; H. W. Libbey, Boston, Mass. App. filed March 10, 1897. In a railroad, an electric conductor supported by the side of the rail, a T-piece consisting of a number of sections insulated from each other and supported by springs from the web of the rail, and spring contact pieces consisting of two discs of hard rubber, a cylinder of soft rubber and a metal rod passing through the centre.

597,213. TELEPHONE ATTACHMENT; P. J. Bose, Bremen, Germany. App. filed Nov. 16, 1896. The combination with a telephone call box, fitted with the usual 'phone-supporting hook, of a vertical rod pivotally supported in bearings at its ends, provided with an arm fixedly secured thereto, and projecting therefrom to support the receiving instrument, a spring for holding said arm toward the user of the instrument, and an arm fastened to said vertical rod to swing across and press down said hook for closing the call-bell circuit when the instrument is not in use.

597,228. ADJUSTABLE SWITCHBOARD; H. H. and F. D. Walker, Philadelphia, Pa. App. filed Sept. 23, 1897. In an adjustable switchboard, a plurality of plates, wings attached to the latter and adapted to contact with each other in whatever position said plates may assume, and means for making electrical connections to said wings.

597,239. PRIMARY BATTERY; C. J. and H. C. Hubbell, Scranton, Pa. App. filed May 8, 1897. In a primary battery, a negative element having a central vertical cylindrical enlargement provided at its lower end with a



No. 597,228.—Adjustable Switchboard.

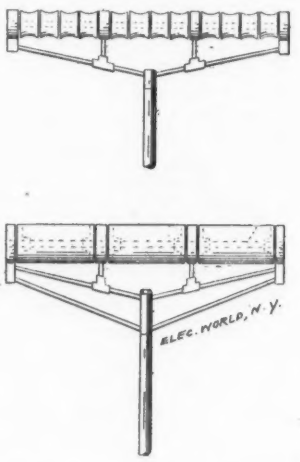
depending lug, in combination with a metallic ring or thimble surrounding said lug.

597,244. COMBINATION GAS AND ELECTRIC LIGHT FIXTURE; J. W. Parkin, Philadelphia, Pa. App. filed Dec. 23, 1896. In a combination gas and electric light fixture, having a body portion with a passage therein, a controlling cock, a plug in said body portion, tubing having adjacent passages, the said passage communicating with a passage in said plug leading from said passage, said body portion having a chamber therein, a ring in said chamber, separated from the wall thereof by insulation, an insulated-contact device having a member adapted to contact with said ring, and an electric conductor passing through said chamber and through a passage adjacent to said plug, and having connected thereto the upward extension connecting with said ring.

597,265. CONTROLLER FOR ELECTRIC MOTORS; C. S. Cook, Pittsburg, Pa. App. filed Jan. 2, 1897. The combination with an electric motor, having a shunt or compound-wound field magnet, of a starting, stopping and reversing switch therefor, provided with means for reversing the direction of current flow in the armature winding, and maintaining a closed circuit, which includes the armature and shunt windings in series with each other, and constitute the only path for current during the reversing operation.

597,282. TROLLEY GUARD; H. F. Hendricks and J. H. Denton, Philadelphia, Pa. App. filed Sept. 12, 1896. In a trolley, a fork, a bolt secured thereto, a trolley wheel journaled on the bolt, diverging brackets secured to the bolt at an angle to the disc, a second bolt connecting the brackets, a secondary trolley wheel journaled on the second bolt between the brackets, and star wheels journaled on the second bolt outside the brackets.

597,306. CURRENT-COLLECTING MEANS FOR ELECTRIC RAILWAY VEHICLES; C. A. Terry, New York, N. Y. App. filed Sept. 17, 1896. A laterally extending contact device for making contact with overhead supply conductors, comprising a plurality of electrically connected rotatable elements of substantially thesame diameter, and a supporting frame having a horizontal bearing rod upon which said rotatable elements are mounted.



No. 597,306.—Current Collecting Means for Electric Railway Vehicles.

597,374. CONTROLLER FOR ELECTRIC CARS; J. C. Henry, Denver, Col. App. filed Nov. 6, 1897. The method of braking electric cars, consisting in changing the armature of two electric motors propelling said car, from parallel to series connections, increasing the magnetization of the fields of said motors as the current in the armature decreases, due to retardation of the speed of the motors, and then short-circuiting the armatures of the motors under separately excited fields.